

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
27 December 2002 (27.12.2002)

PCT

(10) International Publication Number
WO 02/103504 A2

(51) International Patent Classification⁷:

G06F 1/18

(21) International Application Number: PCT/US02/18953

(22) International Filing Date: 13 June 2002 (13.06.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

60/298,364 15 June 2001 (15.06.2001) US
60/315,571 28 August 2001 (28.08.2001) US
10/075,964 13 February 2002 (13.02.2002) US
10/075,520 13 February 2002 (13.02.2002) US

(71) Applicant: APPLE COMPUTER, INC. [US/US];
PAT-38, 1 Infinite Loop, Cupertino, CA 95014 (US).

(72) Inventor: KERR, Duncan; 59 Collingwood Street, Apt.
5, San Francisco, CA 94114 (US).

(74) Agent: HOELLWARTH, Quin; Beyer Weaver &
Thomas, LLP, 2030 Addison Street, 7th Floor, P.O. Box
778, Berkeley, CA 94704 (US).

(81) Designated States (national): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GB, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI,
SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA,
ZW.

(84) Designated States (regional): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian
patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European
patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,
IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF,
CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD,
TG).

Published:

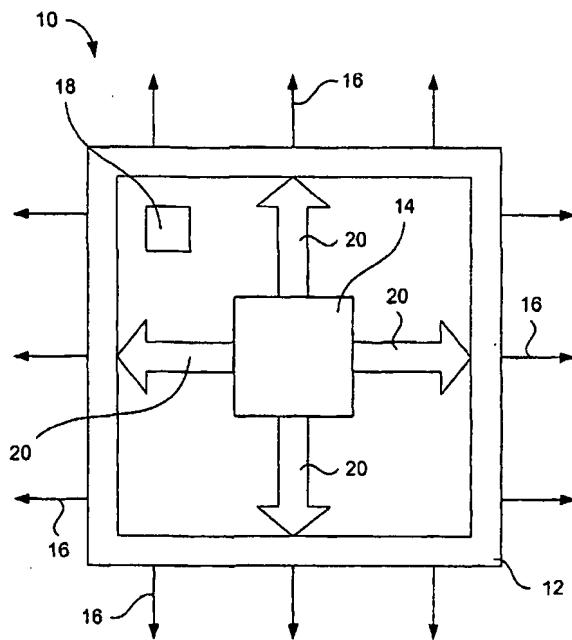
— without international search report and to be republished
upon receipt of that report

[Continued on next page]

(54) Title: ACTIVE ENCLOSURE FOR COMPUTING DEVICE



WO 02/103504 A2



(57) Abstract: A computing device is disclosed. The computing device includes a housing having an illuminable portion. The computing device also includes a light emitting device disposed inside the housing. The light emitting device is configured to produce a light effect that alters the ornamental appearance of the computing device.

WO 02/103504 A2



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

ACTIVE ENCLOSURE FOR COMPUTING DEVICE

5

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a computing device. More particularly, the present invention relates to improved features for changing the appearance of a 10 computing device.

2. Description of the Related Art

Most computing devices, including portable computers and desktop computers, give feedback to its user via a display screen or speakers. As is generally well known, 15 display screens are used to display textual or graphical information to a user and speakers are used to output sound to the user. For example, display screens may be used to display a graphical user interface (GUI) and speakers may be used to output music or audio messages. Computing devices also give feedback to users via small indicators positioned on the computing device. By way of example, some indicators use light to 20 indicate that a computing device (or the display screen of the computing device) is turned on/off or that a disk drive is reading or writing data to a disk. Although displays, speakers and indicators work well, they are limited to the type of feedback they give a user. For example, while playing a movie with a DVD drive of a computing device, the display screen only outputs the video associated with the movie, the speaker only 25 outputs the audio associated with the movie, and the indicator only indicates that a movie is playing the DVD drive. Thus, it would be desirable to provide additional feedback to a user.

Computing devices also have housings that enclose the components and circuitry 30 associated with operating the computing devices. Housings generally serve to shield and protect the components and circuitry from adverse conditions such as impact and dust. In some cases, the housings are configured to surround all the components of the computing device while in other cases the housings are configured to surround individual or a subset of components. For example, a housing may be used to enclose

the central processing unit (CPU), display screen, disk drive, and speaker to form a single unit. As another example, a plurality of different housings may be used to individually enclose the CPU, display screen, disk drive and speakers to form a plurality of individual units.

5

As is generally well known, housings for computing devices in particular product lines are typically manufactured with the same appearance, i.e., they look the same. For example, housings from a particular product line may have the same box-like shape and/or the same neutral color. This can be discouraging to computer users who desire 10 computers that are more personalized or to computer users who desire computers that are different than another user's computer. Recently, manufacturers have attempted to remedy this problem by offering brightly colored or translucent housings for computing devices. For example, some computer and telephone manufacturers now sell a variety of housings, which have different colors and patterns. By way of example, the iMAC ® 15 computer, which is produced by Apple Computer of Cupertino, CA, is available in various colors and patterns.

Although these recent advances make substantial inroads to overcoming the same old appearance, the housings for the computing device remain passive structures that 20 exhibit a non-adaptable or non-changing appearance. That is, a colored or patterned housing has a single color or pattern associated therewith that does not change overtime.

External lights have been used in some devices associated with displaying video to enhance the viewing experience of the video. Unfortunately, however, none of the 25 external lights have been capable of changing the visual appearance of the device housing. That is, the external lights are typically located outside the periphery of the housing and are typically arranged to alter the environment in which the video is shown rather than the device housing itself (the appearance of the housing remains the same even with the use of lights).

30

Thus, there is a need for improvements in appearances of housings for computing devices.

SUMMARY OF THE INVENTION

The invention relates, in one embodiment, to a computing device. The computing device includes an illuminable housing having a housing wall configured to allow the passage of light. The computing device also includes a light emitting device disposed inside the illuminable housing. The light emitting device is configured to produce a light effect that alters the ornamental appearance of the computing device.

The invention relates, in another embodiment, to a computer system having a housing for enclosing at least one component of the computer system. The housing has a light passing wall. The computer system includes a light source disposed inside the housing. The light source is configured to generate light. The computer system also includes a light controller operatively coupled to the light source. The light source controller is configured to control the light source so as to illuminate at least a portion of the light passing wall of the housing with the light generated by the light source.

The invention relates, in another embodiment, to a general purpose computer having the ability to alter its ornamental appearance. The general purpose computer includes a housing. The general purpose computer also includes a computer component disposed inside the housing. The general purpose computer further includes a light arrangement disposed inside the housing. The light arrangement is configured to illuminate a substantial portion of the housing so as to alter the ornamental appearance of the housing.

The invention relates, in another embodiment, to a general purpose computer. The general purpose computer includes a housing including one or more walls that define the outer peripheral form of the general purpose computer. One of the walls has an illuminable portion configured to allow the passage of light therein. The general purpose computer also includes a light emitting device enclosed by the housing. The light emitting device is configured to generate light so as to illuminate at least a portion of the light passing wall thus altering the ornamental appearance of the general purpose computer. The general purpose computer further includes a processor enclosed by the housing. The processor is configured to at least partially control the operations of the general purpose computer.

The invention relates, in another embodiment, to a display for use with a general purpose computer. The display includes a housing including one or more wall that define the outer peripheral form of the display. One of the light walls is a light passing wall configured to allow the passage of light therethrough. The display also includes a light arrangement enclosed by the housing. The light arrangement is configured to generate light so as to illuminate the light passing wall thus altering the ornamental appearance of the display. The display further includes a display screen partially enclosed by the housing. The display screen is configured to display text or graphics via a graphical user interface.

The invention relates, in another embodiment, to a computing device. The computing device includes an enclosure having an illuminable wall in optical communication with a light source disposed inside the enclosure. The illuminable wall and the light source working together to emit a characteristic glow at a peripheral portion of the enclosure.

The invention relates, in another embodiment, to an electronic device. The electronic device includes a housing configured to define the outer peripheral form of the electronic device. The electronic device also includes a distinct first component disposed inside the housing and capable of inputting or outputting information associated with the operation of the electronic device. The electronic device further includes a distinct second component disposed inside the housing and capable of outputting light so as to illuminate a substantial portion of the housing in order to effect the ornamental appearance of the electronic device.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be readily understood by the following detailed description in
5 conjunction with the accompanying drawings, wherein like reference numerals designate
like structural elements, and in which:

Fig. 1 is a simplified diagram of an electronic device, in accordance with one
embodiment of the present invention.

10

Fig. 2 is a block diagram of a computer system, in accordance with one
embodiment of the present invention.

15

Fig. 3 is a block diagram of a computer system, in accordance with another
embodiment of the present invention.

Fig. 4 is a block diagram of a computer system, in accordance with another
embodiment of the present invention.

20

Fig. 5 is a block diagram of a computer system, in accordance with another
embodiment of the present invention.

Fig. 6 is a block diagram of a computer system, in accordance with another
embodiment of the present invention.

25

Fig. 7 is a block diagram of a computer system, in accordance with another
embodiment of the present invention.

30

Fig. 8 is a perspective diagram of a computer system, in accordance with one
embodiment of the present invention.

Fig. 9 is a perspective diagram of a computer system, in accordance with another
embodiment of the present invention.

Fig. 10 is a side view of a LED array, in accordance with one embodiment of the present invention.

5 Fig. 11A is a simplified illustration showing color mixing via the LED array of Fig. 10, in accordance with one embodiment of the present invention.

Fig. 11B is a graphical illustration showing color mixing via the LED array of Fig. 10, in accordance with one embodiment of the present invention.

10 Fig. 12 is a perspective diagram of a computer, in accordance with one embodiment of the present invention.

Fig. 13 is a top view of a computer, in accordance with one embodiment of the present invention.

15 Fig. 14 A-C are broken away top views, in cross section, of a wall of a computer, in accordance with several embodiments of the present invention.

20 Fig. 15 is a perspective diagram of a computer, in accordance with one embodiment of the present invention.

Fig. 16 is a top view of a computer, in accordance with one embodiment of the present invention.

25 Fig. 17 is a perspective diagram of a computer, in accordance with one embodiment of the present invention.

Fig. 18 A-D are broken away top views, in cross section, of a wall of a computer, in accordance with several embodiments of the present invention.

30 Fig. 19 is a perspective diagram of a computer, in accordance with one embodiment of the present invention.

Fig. 20 is a top view of a computer, in accordance with one embodiment of the present invention.

5 Fig. 21 is a simplified diagram of a light source arrangement, in accordance with one embodiment of the present invention.

Fig. 22 is a simplified diagram of a light source arrangement, in accordance with one embodiment of the present invention.

10 Fig. 23 is a simplified diagram of a light source arrangement, in accordance with one embodiment of the present invention.

Fig. 24 is a top view of a computer having a light reflecting system, in accordance with one embodiment of the present invention.

15 Fig. 25 is a simplified diagram of a chameleonic electronic device, in accordance with one embodiment of the present invention.

Fig. 26 is a broken away diagram of a general purpose computer, in accordance
20 with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The invention pertains to electronic devices capable of changing their ornamental or decorative appearance, i.e., the outer appearance as seen by a user. The electronic devices generally include an illuminable housing. The illuminable housing, which includes at least one wall configured for the passage of light, is configured to enclose, cover and protect a light arrangement as well as functional components of the electronic device. For example, in the case of a desktop computer, the functional components may include a processor for executing instructions and carrying out operations associated with the computer, and in the case of a display monitor, the functional components may include a display for presenting text or graphics to a user. The light arrangement, which generally includes one or more light sources, is configured to produce light for transmission through the light passing wall (or walls) of the illuminable housing. As should be appreciated, the transmitted light illuminates the wall (s) thus giving the wall a new appearance, i.e., the color, pattern, behavior, brightness and/or the like. That is, the transmitted light effectively alters the ornamental or decorative appearance of the electronic device. By way of example, a light source capable of producing green light may cause the light passing wall to exude green.

20

In most cases, the light is controlled so as to produce a light effect having specific characteristics or attributes. As such, the electronic device may be configured to provide additional feedback to the user of the electronic device and to give users the ability to personalize or change the look of their electronic device on an on-going basis. That is, a housing of the electronic device is active rather than passive, i.e., the housing has the ability to adapt and change. For example, the light may be used to exhibit a housing behavior that reflects the desires or moods of the user, that reflects inputs or outputs for the electronic device, or that reacts to tasks or events associated with operation of the electronic device.

25

It is contemplated that the present invention may be adapted for any of a number of suitable and known consumer electronic products that perform useful functions via electronic components. By way of example, the consumer electronic products may relate to computing devices and systems that process, send, retrieve and/or store data.

The computing devices and systems may generally relate to desktop computers (both segmented and all-in-one machines) that sit on desks, floors or other surfaces, portable computers that can be easily transported by a user, or handheld computing devices. By way of example, portable computers include laptop computers, and handheld computing devices include personal digital assistants (PDAs) and mobile phones.

5 Embodiments of the invention are discussed below with reference to Figs. 1 – 26. However, those skilled in the art will readily appreciate that the detailed description given herein with respect to these figures is for explanatory purposes as the invention 10 extends beyond these limited embodiments.

Fig. 1 is a simplified diagram of a chameleonic electronic device 10, in accordance with one embodiment of the invention. The word "chameleonic" refers to the fact that the electronic device 10 has the ability to alter its visual appearance.

15 The chameleonic electronic device 10 generally includes a housing 12 configured to form an external protective covering of the chameleonic electronic device 10 and a light system 14 configured to adjust the illuminance or pigmentation of the housing 12. The housing 12 of the chameleonic electronic device 10 surrounds and protects internal components 18 disposed therein. The internal components 18 may be a plurality of 20 electrical components that provide specific functions for the chameleonic electronic device 10. For example, the internal electrical components 18 may include devices for generating, transmitting and receiving data associated with operating the electronic device. In one embodiment, the chameleonic electronic device is a component of a computer system, as for example, a general purpose computer. As such, the internal 25 electrical components may include a processor, memory, controllers, I/O devices, displays and/or the like.

The chameleonic electronic device 10 is configured to change its visual appearance via light. That is, the housing 12 is configured to allow the passage of light 30 and the light system 14 is configured to produce light for transmission through the housing 12. In one embodiment, the light system 14 includes a light arrangement (not shown). The light arrangement, which is disposed inside the housing 12 and which includes at least one light source, is configured to emit light 20 incident on the inner surface of the housing 12. As should be appreciated, light 22 that is transmitted through

the wall of the housing 12 changes the look of the housing 12 and thus the visual appearance of the chameleonic electronic device 10. By way of example, the light 20 may cause the housing 12 to exude a specific brightness such as intense or dull light, a specific color such as green, red or blue, a specific pattern such as a rainbow or dots , or 5 a changing behavior such as a strobe effect or fading in/out.

In some cases, the light system 14 is arranged to cooperate with the electrical components 18. For example, events associated with the electrical components 14 may be monitored, and the light system 14 may be controlled based on the monitored events. 10 As such, an illumination effect corresponding to a specific event may be produced. For example, the housing 12 may be configured to exude a blinking red coloration when an event has been implemented. Although the light system 14 may cooperate with the electrical components 18, it should be understood that the electrical components 18 and the light system 14 are distinct devices serving different functions. That is, the electrical 15 components 18 are generally configured to perform functions relating to operating the chameleonic electronic device 10, and the light system 14 is generally configured to change the appearance of the housing 12 thereof.

Fig. 2 is a block diagram of a computer system 100, in accordance with one 20 embodiment of the present invention. By way of example, the computer system 100 may correspond to the electronic device 10 shown in Fig. 1. The computing system 100 generally includes a processor 102 (e.g., CPU or microprocessor) configured to execute instructions and to carry out operations associated with the computer system 100. By way of example, the processor 102 may execute instructions under the control of an 25 operating system or other software.

The computing system 100 also includes an input/output (I/O) controller 104 that is operatively coupled to the processor 102. The I/O controller 104 is generally configured to control interactions with one or more I/O devices 106 that can be coupled 30 to the computing system 100. The I/O controller 104 generally operates by exchanging data between the computing system 100 and the I/O devices 106 that desire to communicate with the computing system 100. In some cases, the I/O devices 106 may be connected to the I/O controller 104 through wired connections such as through wires or cables. In other cases, the I/O devices 106 may be connected to the I/O controller 104

through wireless connections. By way of example, the I/O devices 106 may be internal or peripheral devices such as memory, disk drives, keyboards, mice, printers, scanners, speakers, video cameras, MP3 players and the like. The I/O devices 106 may also be network-related devices such as network cards or modems.

5

The computing system 100 additionally includes a display controller 108 that is operatively coupled to the processor 102. The display controller 108 is configured to process display commands to produce text and graphics on a display device 110. By way of example, the display 110 may be a monochrome display, color graphics adapter (CGA) display, enhanced graphics adapter (EGA) display, variable-graphics-array (VGA) display, super VGA display, liquid crystal display (LCD), cathode ray tube (CRT), plasma displays and the like.

The computing system 100 further includes a light source controller 112 that is operatively coupled to the processor 102. The light source controller 112 generally provides processing of light commands from the processor 102 to produce light 116 in a controlled manner via a light source 114. By way of example, the light source 114 may be one or more light emitting diodes (LED), light emitting semiconductor dies, lasers, incandescent light bulbs, fluorescent light bulbs, neon tubes, liquid crystal displays (LCD), and the like, that are arranged to produce light and more particularly colored light. The light source 114 is generally disposed inside an enclosure 120 that covers and protects some aspect of the computing system 100. More particularly, the enclosure 120 can cover and protect one or more computer components having functionality used in the operation of the computing system 100. By way of example, the enclosure 120 may be configured to cover one or more of the components described above. The enclosure 120 generally includes a wall 122 that is configured for transmitting light therethrough. As such, at least a portion of the light 116, which is made incident on the wall 122 via the light source 114, passes through the wall 122, thereby producing a light effect 124 that alters the visual appearance of the enclosure 120 and thus the visual appearance of the computing system 100.

Light effects are generally defined as the way in which the light 116, produced by the light source 114 and controlled by the light source controller 112, acts or influences the enclosure 120. Metaphorically speaking, the enclosure is the canvas, the

light is the paint, and the light effect is the painting. Accordingly, in some cases, the light effect is arranged to cover the entire wall 122 while in other cases, the light effect is arranged to cover only a portion of the wall 122.

5 Light effects may be categorized as static (non-changing over time) or dynamic (changing over time). By way of example, static light effects may cause the enclosure to continuously exude a fixed color such as blue, a fixed shade of a color such as light blue, a fixed pattern or artistic design such as rainbow, stripes, dots, flowers and the like, or a fixed orientation such as a color or pattern located in a specific region of the enclosure.

10 In addition, dynamic light effects may cause the enclosure to exude different colors, intensities or patterns at different times and in different orientations. That is, the coloration, intensities, patterns and position thereof may vary. For example, dynamic light effects may include light effects that change at least partially from a first color, intensity or pattern to a second color, intensity or pattern (e.g., from red to blue to light

15 blue to rainbow, blinking on and off or fading in and out), that change regionally around the enclosure (e.g., moving from a first side to a second side of the enclosure, moving from center to outer, moving around the enclosure in a continuous fashion, a pattern that starts at a certain point on the enclosure and radiates out, etc.), or any combination thereof.

20

 In one embodiment, computer illumination processing may be performed by the computer system when events associated with the computer system occur in or outside the system. The illumination processing generally provides the computer system with an illumination effect, as for example, the illumination of a housing associated with the computer system. In general, illumination processing includes monitoring events associated with the computer system (e.g., software or hardware) and controlling the light source based on the monitored events so as to provide a housing associated with the computer system with an ornamental appearance corresponding to the monitored event. The events being monitored are generally identified by an operating system or a

25 microprocessor utilized within the computer system. The events can take many forms such as operating system events or microprocessor events. By way of example, the events may relate to signals, conditions or status of the computer system. Examples of illumination processing are described in greater detail in a co-pending patent application entitled, "COMPUTING DEVICE WITH DYNAMIC ORNAMENTAL

APPEARANCE"; (Attorney Docket No.: APL1P218), filed on even date and incorporated herein by reference.

Although not shown in Fig. 2, the computer system may include other 5 components such as buses, bridges, connectors, wires, memory, and the like. As is generally well known, buses provide a path for data to travel between components of the computer system 100. In addition, bridges serve to perform adjustments necessary to bridge communication between different buses, i.e., various buses follow different standards. Further, memory provides a place to hold data that is being used by the 10 computer system. By way of example, memory may be a Read-Only Memory (ROM) or a Random-Access Memory (RAM). RAM typically provides temporary data storage for use by at least the processor 102, and ROM typically stores programming instructions for use with the processor 102.

15 In one embodiment, the illumination characteristics of the light system that produce the light effects may be determined by predetermined configuration information stored in a database, i.e., the computer system consults the information held in the database in order to determine the illumination characteristics. Illumination characteristics generally refer to how a housing associated with the computer is 20 illuminated to produce an ornamental appearance (e.g., which lights are operated, how long the light sources are operated, what color the light source output, etc.). The predetermined configuration information stored in the database may be accessed by a user through a light control menu, which may be viewed on a display screen as part of a GUI interface. The light control menu may include light control settings pertaining to 25 the illumination characteristics. In fact, the light control menu may serve as a control panel for reviewing and/or customizing the light control settings, i.e., the user may quickly and conveniently review the light control settings and make changes thereto. Once the user saves the changes, the modified light control settings will be employed (e.g., as predetermined configuration information) to handle future illumination 30 processing.

Referring now to Figs. 3-7, the placement of the enclosure 120 relative to the components described above will be described in greater detail. In one embodiment, the enclosure 120 is configured to cover the entire computer system described above. For

example, in Fig. 3, the enclosure 120 is configured to cover the processor 102, the I/O controller 104, the I/O device 106, the display controller 108, the display 110, the light controller 112 and the light source 114.

5 In another embodiment, the enclosure 120 is configured to cover only a portion of the computer system described above. For example, in Fig. 4, the illuminable enclosure 120 is configured to cover the processor 102, the I/O controller 104, the display controller 108, the light controller 112 and the light source 114. In Fig. 5, the illuminable enclosure 120 is configured to cover the display 110 and the light source 10 114. In Fig. 6, the illuminable enclosure 120 is configured to cover a peripheral I/O device (e.g., the I/O device 106) and the light source 114.

In yet another embodiment, the enclosure 120 can represent a plurality of enclosures that are configured to separately cover individual or sets of components of the 15 computer system 100 described above. For example, in Fig. 7, a first enclosure 120A is configured to cover the processor 102, the I/O controller 104, an internal I/O device 106I, the display controller 108, the light controller 112 and a first light source 114A. In addition, a second enclosure 120B is configured to cover the display 110 and a second 20 light source 114B. A third enclosure 120C is configured to cover a peripheral I/O device 106P and a third light source 114C. It should be understood that Figs. 4-7 are representative embodiments and thus not limitations, thus it should be recognized that other configurations of the enclosure(s) may be used.

25 In one embodiment, the computer system corresponds to a general purpose computer such as an IBM compatible computer or an Apple compatible computer. By way of example, the Apple compatible computer may include different models such as the iMac, G3, G4, Cube, iBook, or Titanium models, which are manufactured by Apple Computer, Inc. of Cupertino, CA.

30 Fig. 8 is a perspective diagram of a general purpose computer 130, in accordance with one embodiment of the invention. By way of example, the general purpose computer 130 may correspond to the computer system 100 shown in Figs. 4 or 5. The computer 130 generally includes a base 132 and a monitor 134 (or display) operatively coupled to the base 132. In the illustrated embodiment, the base 132 and monitor 134

are separate components, i.e., they each have their own housing. That is, the base 132 includes a base housing 138 and the monitor 134 includes a monitor housing 139. Both housings are configured to enclose various internal components associated with operation of the respective devices. In general, the housings 138, 139 serve to surround their internal components at a peripheral region thereof so as to cover and protect their internal components from adverse conditions.

With regards to the base 132, the internal components may be processors, controllers, bridges, memory and the like. Often these internal components take the format of integrated circuits; however, the internal components can take various other forms (e.g., circuit boards, cables, fans, power supplies, batteries, capacitors, resistors). The internal components may also be various I/O devices such as a hard drive, a disk drive, a modem and the like. The base 132 may also include a plurality of I/O connectors for allowing connection to peripheral devices such as a mouse, a keyboard, a printer, a scanner, speakers and the like. In the illustrated embodiment, the base housing 138 serves to surround at least a processor and a controller. By way of example, the controller may be an input/output (I/O) controller, a display controller, a light source controller and/or the like. With regards to the monitor 134, the internal components may be a display screen. As is generally well known, the display screen is used to display the graphical user interface (including perhaps a pointer or cursor) as well as other information to a user.

In most cases, the housings 138, 139 include one or more walls 142, 143, respectively, that serve to structurally support the internal components in their assembled position within the housings. The walls 142, 143 also define the shape or form of the housings, i.e., the contour of the walls embody the outward physical appearance of the housings. The contour may be rectilinear, curvilinear or both. In the illustrated embodiment, the base housing 138 includes six (6) rectangular and planar walls that form a box-shaped housing. It should be understood, however, that this is not a limitation and that the form and shape of the housings may vary according to the specific needs or design of each computer system. By way of example, the housing may be formed in simple shapes such as a cube, a cylinder, a pyramid, a cone, or a sphere, or in complex shapes such as a combination of simple shapes or an object such as an apple, a house, a car or the like.

In one embodiment, the base housing 138 includes at least one light passing wall configured to allow the passage of light. In most cases, the light passing wall constitutes a significant percentage area of the housing. In the illustrated embodiment, the entire 5 housing 138 is illuminable and thus all six of the rectangular and planar walls 142 are configured to allow the passage of light. It should be noted, however, that this is not a limitation and that the amount of light passing walls may vary according to the specific needs of each computer system. For example, the housing may include any number of opaque walls and light passing walls. Still further, a light passing wall need not pass 10 light over its entire surface. In other words, only a non-trivial portion of a wall needs to pass light to be considered a light passing wall. The light passing walls are generally formed from a translucent or semi-translucent medium such as, for example, a clear and/or frosted plastic material.

15 For ease of discussion, a portion of the wall 142 has been removed to show a light source 140A disposed inside the housing 138. The light source 140A is configured to generate light 144A so as to illuminate the interior of the housing 138, and more particularly the interior of the light passing walls 142. The light 144A, which is made incident on the interior of the walls 142 by the light source 140A, is thereby transmitted 20 through the walls 142 of the housing 138 to produce a light effect 146A that alters the visual appearance of the housing 138 and thus the visual appearance of the base 132. That is, the light 144A generated inside the housing 138 and passing through the walls 142 effectively changes the visual appearance of the housing 138 as seen by a user when looking at the housing 138. By way of example, the light effect 146A may cause 25 housing 138 to exude a fixed or varying color or pattern. Although a single light source 140A is shown in Fig. 5, it should be noted that this is not a limitation and that a plurality of light sources may be used. For example, individual light sources may be strategically positioned within the housing 138 so as to illuminate specific zones or regions of the housing 138.

30

In another embodiment, the monitor housing 139 includes at least one light passing wall configured to allow the passage of light. In most cases, the light passing wall constitutes a significant percentage area of the housing. In the illustrated embodiment, the entire housing 139 is illuminable and thus all of its walls 143 are

configured to allow the passage of light. It should be noted, however, that this is not a limitation and that the amount of light passing walls may vary according to the specific needs of each computer system. For example, the housing may include any number of opaque walls and light passing walls. Still further, a light passing wall need not pass light over its entire surface. In other words, only a non-trivial portion of a wall needs to pass light to be considered a light passing wall. The light passing walls are generally formed from a translucent or semi-translucent medium such as, for example, a clear and/or frosted plastic material.

10 Again, for ease of discussion, a portion of the wall 143 has been removed to show a light source 140B disposed inside the housing 139. The light source 140B is configured to generate light 144B so as to illuminate the interior of the housing 139, and more particularly the interior of the light passing walls 143. The light 144B, which is made incident on the interior of the walls 143 by the light source 140B, is thereby 15 transmitted through the walls 143 of the housing 139 to produce a light effect 146B that alters the visual appearance of the housing 139 and thus the visual appearance of the monitor 134. That is, the light 144B generated inside the housing 139 and passing through the walls 143 effectively changes the visual appearance of the housing 139 as seen by a user when looking at the housing 139. By way of example, the light effect 20 146B may cause housing 139 to exude a fixed or varying color or pattern. Although a single light source 140B is shown in Fig. 5, it should be noted that this is not a limitation and that a plurality of light sources may be used. For example, individual light sources may be strategically positioned within the housing 139 so as to illuminate specific zones or regions of the housing 139.

25 Fig. 9 is a perspective diagram of a general purpose computer 150, in accordance with another embodiment of the invention. By way of example, the general purpose computer 150 may correspond to the computer system shown in Figs. 4 or 5. The general purpose computer 150 includes an all in one machine 151 that integrates the base and monitor of Fig. 6 into a single housing 152. The housing 152 is generally 30 configured to enclose various internal components associated with operation of the computer 150. In general, the housing 152 serves to surround the internal components at a peripheral region thereof so as to cover and protect the internal components from adverse conditions. In one embodiment, the housing 152 includes a plurality of cases

164 that cooperate to form the housing 152. Any number of cases may be used. In the illustrated embodiment, the cases 164 consist of a bottom case 164A, a top case 164B and a front case 164C.

5 The internal components may be processors, controllers, bridges, memory and the like. Often these internal components take the format of integrated circuits; however, the internal components can take various other forms (e.g., circuit boards, cables, fans, power supplies, batteries, capacitors, resistors). In the illustrated embodiment, the housing 152 serves to surround at least a processor and a controller.

10 By way of example, the controller may be an input/output (I/O) controller, a display controller, a light source controller and/or the like. The internal components may also be various I/O devices such as a hard drive, a disk drive, a modem and the like. For example, as shown, the computer 150 may include a disk drive 166 and a display 168. The disk drive 166 is used to store and retrieve data via a disk. The display 168 is used

15 to display the graphical user interface (including perhaps a pointer or cursor) as well as other information to the user. The all in one machine 151 may also include a plurality of I/O connectors for allowing connection to peripheral devices such as a mouse, a keyboard, a printer, a scanner, speakers and the like. By way of example, the computer system 150 may include I/O port connectors for connection to peripheral components

20 such as a keyboard 170 and a mouse 172. The keyboard 170 allows a user of the computer 150 to enter alphanumeric data. The mouse 172 allows a user to move an input pointer on a graphical user interface and to make selections on the graphical user interface.

25 In most cases, the housing 152 includes one or more walls 156 that serve to structurally support the internal components in their assembled position within the housing. The walls 156 also define the shape or form of the housing, i.e., the contour of the walls embody the outward physical appearance of the housing. The contour may be rectilinear, curvilinear or both.

30

In one embodiment, the housing 152 includes one or more light passing walls having light passing portions, which are configured to allow the passage of light. The light passing portions may be an edge of the wall or a surface of the wall. The light passing portions may constitute the an entire wall or a portion of a wall, i.e., a light

passing wall need not pass light over its entire surface. In other words, only a non-trivial portion of a wall needs to pass light to be considered a light passing wall. In most cases, the light passing portions constitute a significant percentage area of the light passing wall. For example, the amount of light passing area is generally determined by the 5 amount of light needed to pass through the housing in order to effectively change the appearance of the housing so that a user feels differently about the device (e.g., not an indicator). Any suitable arrangement of light passing walls, light passing portions and opaque walls may be used so long as the outward appearance of the system changes.

10 In the illustrated embodiment, the walls 156' provided by the top case 164 are light passing walls, which are illuminated with light from a light source 154 disposed inside the housing 152. For ease of discussion, a portion of the wall 156' has been removed to show the light source 154 disposed therein. The light source 154 is configured to generate light 160 so as to illuminate the interior of the housing 152, and 15 more particularly the interior of the wall 156'. In general, the light 160, which is made incident on the wall 156' by the light source 154, is transmitted through the wall 156' to produce a light effect 162 that alters the visual appearance of the housing 152 and thus the visual appearance of the computer system 150. That is, the light 160 generated inside the housing 152 and passing through the wall 156' effectively changes the visual 20 appearance of the housing 152 as seen by a user when looking at the housing 152.

The light source 154 is operatively coupled to a light source controller (not shown) that cooperates with the light source 154 to produce the light 160. In general, the light source 154 provides the light 160 for illuminating the housing 152, and more 25 particularly the wall 156, and the light source controller provides processing of light commands to produce the light in a controlled manner. In some implementations, the light 160 is arranged to produce the light effect 162 at a surface 174 of the wall 156. In other implementations, the light 160 is arranged to produce the light effect 162 at an edge 176 of the wall 156. In yet other implementations, the light 160 is arranged to 30 produce a light effect 162 at both the surface 174 and the edge 176 of the wall 156.

To elaborate further, according to one embodiment, the light source 154 is generally configured to include at least one light emitting diode (LED). LED's offer many advantages over other light sources. For example, LED's are relatively small

devices that are energy efficient and long lasting. LED's also run relatively cool and are low in cost. Furthermore, LED's come in various colors such as white, blue, green, red and the like. In most cases, the light source 154 includes a plurality of LED's that cooperate to produce the desired light effect. The plurality of LED's may be a plurality of individual LED's or a plurality of integrated LED arrays having a plurality of individual LED's that are grouped together.

5 In one embodiment, the individual LED's, whether by themselves or grouped together in an array, are the same color. As such, the same colored LED's can produce a 10 light effect 162 that is one color or at least one shade of one color. This typically can be done by simultaneously maintaining the same light intensity for all of the LED's via the light source controller. The same colored LED's can also produce a light effect 162 that has a varying coloration. This typically can be accomplished by simultaneously 15 adjusting the light intensities for all of the LED's at the same time via the light source controller. By way of example, this can be done to produce a light effect that blinks or fades in and out.

20 The same colored LED's can also produce a light effect that has a pattern with a plurality of different shades of one color. This is typically accomplished by maintaining different light intensities for different LED's via the light source controller. For example, LED's positioned in a first spatial zone, i.e., a first area of the illuminable 25 housing 152, can produce a first shade of color (a first light intensity) and LED's positioned in a second spatial zone, i.e., a second area of the illuminable housing 152, can produce a second shade of color (a second light intensity). By way of example, the spatially zoned LED's can produce a light effect having stripes, spots, quadrants and the like. The same colored LED's can also produce a light effect 162 that has a varying 30 pattern. This is typically accomplished by activating LED's at different times or by adjusting the intensities of LED's at different times via the light source controller. For example, same colored LED's positioned in a first spatial zone can produce a color at a first time and same colored LED's positioned in a second spatial zone can produce a color at a second time. By way of example, the spatially zoned LED's can produce a light effect that alternates or moves between different zones.

In another embodiment, at least a portion of the individual LED's, whether by themselves or grouped together in an array, are different colors. As such, the different colored LED's can produce a light effect that is a particular color or at least a shade of a particular color. This typically can be accomplished by mixing different colors of light

5 to produce a resultant color of light via the light source controller. The different colored LED's can also produce a light effect 162 that has a varying coloration. This typically can be accomplished by adjusting the intensity of the different colored LED's via the light source controller. By way of example, this can be done to produce a light effect that changes from a first color to a second color (e.g., from blue to green).

10

The different colored LED's can also produce a light effect 162 that has a pattern with a plurality of colors. This typically can be accomplished by activating different colored LED's or LED arrays, which are located at various locations about the computer system, via the light source controller. For example, LED's or LED arrays positioned in a first spatial zone, i.e., a first area of the illuminable housing 152, can produce a first color and LED's positioned in a second spatial zone, i.e., a second area of the illuminable housing 152, can produce a second color. By way of example, the spatially zoned LED's can produce a light effect having rainbow stripes, different colored spots, different colored quadrants and the like. The different colored LED's can also produce a light effect 162 that has a changing pattern. This is typically accomplished by activating different colored LED's at different times or by adjusting the intensities of different colored LED's at different times via the light source controller. The different colored LED's may be in the same spatial zone or a different spatial zone. For example, LED's positioned in a first spatial zone can produce a first colored light at a first time and LED's positioned in a second spatial zone can produce a second colored light at a second time. This can be done in a specific sequence (e.g., red, blue, red, blue, red, blue...) or a random sequence (e.g., green, yellow, red, yellow, blue...).

30 Fig. 10 is a simplified diagram of an integrated LED array 180, in accordance with one embodiment of the invention. By way of example, the integrated LED array 180 (or a plurality of LED arrays 180) may correspond to the light source 154 described in Fig. 8. The integrated LED array 180 generally includes a plurality of individual LED's 182 that produce an overall light effect that is one color at a moment in time. In

the illustrated embodiment, each of the individual LED's 182 represents a different color, as for example, a red LED 182A, a green LED 182B and a blue LED 182C, that cooperate to produce a resultant color C. It is generally believed that these three colors are the primary colors of light and therefore they can be mixed to produce almost any 5 color. That is, the resultant color C may be a wide range of colors, as for example, a majority of the colors from the color spectrum. Although only one LED is shown for each color, it should be noted that this is not a requirement and that the number may vary according to the specific needs of each device.

10 To facilitate discussion, Fig. 11A is a three dimensional graphical representation showing color mixing with regards to the red, green and blue LED's (182A-C). As shown, red light produced by the red LED 182A is designated R, green light produced by the green LED 182B is designated G, and blue light produced by the blue LED 182C is designated B. Furthermore, mixed light produced by the red and green LED's 15 182A&B is designated RG, mixed light produced by the green and blue LED's 182B&C is designated GB, and mixed light produced by the blue and red LED's 182A&C is designated BR. Moreover, mixed light produced by the red, green and blue LED's 182A-C is designated W (for white).

20 Referring now to Fig. 11B (a two dimensional graphical representation showing color mixing with regards to the red, green and blue LED's 182A-C) each of the colors has a range of intensities (I) between a peak intensity 192 and a zero intensity 194. As such, the light source controller can produce almost any color by adjusting the intensity (I) of each of the LED's (182A-C). By way of example, in order to produce the highest 25 shade of red R, the intensities of the green G and blue B are reduced to zero intensity 194 and the intensity of the red R is increased to its peak intensity 192. The highest shades of green and blue can be implemented in a similar manner. In addition, in order to produce a shade of red and green RG, the intensities of the green G and red R are increased to levels above zero intensity 194 while the intensity of blue B is reduced to 30 zero intensity 194. Shades of green and blue GB and blue and red BR can be implemented in a similar manner. Furthermore, in order to produce shades of white, the intensities of the red R, green G and blue B are increased to the same levels above zero intensity 194.

Although the integrated LED array 180 is shown and described as using the three primary colors, it should be noted that this is not a limitation and that other combinations may be used. For example, the integrated LED array may be configured to include only two of the primary colors.

5

Fig. 12 is a perspective diagram of a computer system 210, in accordance with one embodiment of the present invention. By way of example, the computer system 210 may generally correspond to the computer 150 of Fig. 9. The computer system 210 generally includes an illuminable housing 212 that is illuminated with light from a light source 214 disposed therein. The illuminable housing 212 generally includes a translucent or semi-translucent wall 216 configured to allow the passage of light. For ease of discussion, a portion of the wall 216 has been removed to show the light source 214 disposed therein. The light source 214 is generally configured to generate light 218 so as to illuminate a surface of the wall 216 of the illuminable housing 212. That is, the light 218 emitted by the light source 214 is made incident on an inner surface 220 of the wall 216. The light 218 then passes through the wall 216 (width wise) to an outer surface 222 of the wall 216 where it produces a light effect 224 that alters the visual appearance of the wall 216 and thus the visual appearance of the computer system 210.

20

In one embodiment, a characteristic glow is produced at the outer surface 222 of the wall 216 when the light 218 is transmitted through the wall 216. By characteristic glow, it is meant that the coloration of the wall 216 emanates from the wall 216 rather than from the light source 214, i.e., the light 218 is altered during transmission through the wall 216. In most cases, the characteristic glow is produced by a light directing element disposed in or on the wall 216. The light directing element is generally configured to scatter incident light by reflection and/or refraction.

25

To facilitate discussion, Fig. 13 is a top view, in cross section, of the computer system 210 shown in Fig. 11, in accordance with one embodiment of the invention. As shown, the light source 214 consists of a plurality of light emitting diodes 226 (LED's) that are disposed at various positions inside the illuminable housing 212. The LED's 226 may be a single LED 226A or an LED array 226B. The LED's 226 may be positioned in various directions so long as the light 218 is made incident on the inner surface 220 of the wall 216. For example, the axis of the LED's 226 may be pointing directly at the

inner surface 220 or they may be pointing at an angle relative to the inner surface 220. Furthermore, the wall 216 is configured to transmit the light 218 therethrough from the inner surface 220 to an outer surface 222. By way of example, the wall 216 may be formed from a translucent or semi-translucent plastic such as polycarbonate, acrylic and the like. In most cases, the wall 216 is also configured to scatter the transmitted light to produce a characteristic glow 228 that emanates from the outer surface 222 of the wall 216. For instance, the wall 216 may include a light directing element 230 (shown by dotted line) that scatters the light via reflection and/or refraction.

10 In one embodiment, the light directing element 230 is an additive that is disposed inside the wall 216. Referring to Fig. 14A, for example, the wall 216 may include a plurality of light scattering particles 232 (e.g., additives) dispersed between the inner surface 220 and outer surface 222 of the wall 216. As shown, when the light 218 is made incident on the inner surface 220, it is transmitted through the wall 216 until it intersects a light scattering particle 232 disposed inside the wall 216. After intersecting the light scattering particle 232, the light 218 is scattered outwards in a plurality of directions, i.e., the light is reflected off the surface and/or refracted through the light scattering particle thereby creating the characteristic glow 228. By way of example, the light scattering particles 232 may be formed from small glass particles or white pigments. Furthermore, by changing the amount of light scattering particles 232 disposed in the wall 216, the characteristics of the glow can be altered, i.e., the greater the particles the greater the light scattering.

25 In another embodiment, the light directing element 230 is a layer, coating or texture that is applied to the inner or outer surface 220, 222 of the wall 216. Referring to Figs. 14 B and 14C, for example, the wall 216 may include a light scattering coating 234 or a light scattering texture 236 disposed on the inner surface 220 of the wall 216. By way of example, the light scattering coating 234 may be a paint, film or spray coating. In addition, the light scattering texture 236 may be a molded surface of the wall or a sandblasted surface of the wall. As shown, when light 218 is made incident on the inner surface 220, it intersects the light scattering coating 234 or texture applied on the inner surface 220 of the wall 216. After intersecting the light scattering coating 234 or the light scattering texture 236, the light 218 is scattered outwards in a plurality of

directions, i.e., the light is reflected off the surface and/or refracted through the light scattering particle thereby creating the characteristic glow 228.

5 Although not shown, in another embodiment, the thickness of the wall may be altered so as to produce a light scattering effect. It is generally believed that the greater the thickness, the greater the light scattering effect.

10 Fig. 15 is a perspective diagram of a computer system 240, in accordance with another embodiment of the present invention. By way of example, the computer system 240 may generally correspond to the computer 150 of Fig. 9. The desktop computer system 240 generally includes an illuminable housing 242 that is illuminated with light from a light source 244 disposed therein. The illuminable housing 242 generally includes a translucent or semi-translucent wall 246 configured to allow the passage of light. For ease of discussion, a portion of the wall 246 has been removed to show the light source 15 244 disposed therein. The light source 244 is generally configured to generate light 248 so as to illuminate an edge of the wall 246 of the illuminable housing 242. That is, the light 248 emitted by the light source 244 is made incident on an inner edge 250 of the wall 246. The light is then directed through the wall 246 (length wise) to an outer edge 252 of the wall 246 where it produces a light effect 254 that alters the visual appearance 20 of the wall 246 and thus the visual appearance of the computer system 240. In essence, the wall 246 acts like a light pipe that is configured for transferring or transporting light. Light pipes are generally well known in the art.

25 To facilitate discussion, Fig. 16 is a top view, in cross section, of the computer system 240 shown in Fig. 14, in accordance with one embodiment of the invention. As shown, the light source 244 consists of a plurality of light emitting diodes 256 (LED's) that are disposed at various positions inside the illuminable housing 242. The LED's 256 may be a single LED or an LED array. The LED's 256 may be positioned in various directions so long as the light 248 is made incident on the inner edge 250 of the wall 246. For example, the axis of the LED's 256 may be pointing directly at the inner edge 250 or they may be pointing at an angle relative to the inner edge 250. Furthermore, the wall 246 is configured to transmit the light 248 therethrough from the inner edge 250 to the outer edge 252 to produce the light effect 254 that emanates from the outer edge 252 of the wall 246. By way of example, the wall 246 may be formed

from a translucent or semi-translucent plastic such as polycarbonate, acrylic and the like.. In some cases, the wall 246 may include light directing portions 258, 259 that cause the light to reflect back and forth until it exits the outer edge 252.

5 Fig. 17 is a perspective diagram of a computer system 260, in accordance with another embodiment of the present invention. By way of example, the computer system 260 may generally correspond to the computers 150, 210 and 240 of Figs. 9, 12 and 15, respectively. The desktop computer system 260 generally includes an illuminable housing 262 that is illuminated with light from a light source 264 disposed therein. The 10 illuminable housing 262 generally includes a translucent or semi-translucent wall 266 configured to allow the passage of light. For ease of discussion, a portion of the wall 266 has been removed to show the light source 264 disposed therein. The light source 264 is generally configured to generate light 268 so as to illuminate both a surface and an edge of the wall 266 of the illuminable housing 262. That is, the light 268 emitted by 15 the light source 264 is made incident on an inner surface 270 and/or an inner edge 272 of the wall 266. The light is then directed through the wall 266 to an outer surface 274 and an outer edge 276 of the wall 266 where it produces a light effect 278A and 278B that alters the visual appearance of the wall 266 and thus the visual appearance of the computer system 260.

20 In one embodiment, the light 268 emitted by the light source 264 is made incident on both the inner edge 272 and inner surface 270 of the wall 266 via a plurality of LED's or LED arrays. Referring to Fig. 18A, for example, the light source 264 includes at least a first LED 279 and a second LED 280. The first LED 279 is 25 configured to generate a first light 282 so as to illuminate a surface of the wall 266 of the illuminable housing 262 and the second LED 280 is configured to generate a second light 284 so as to illuminate an edge of the wall 266 of the illuminable housing 262. With regards to the first LED 278, the first light 282 is first made incident on the inner surface 270 of the wall 266 and then it is directed through the wall 266 (width wise) to 30 the outer surface 274 of the wall 266 where it produces the light effect 278A. With regards to the second LED 280, the second light 284 is first made incident on the inner edge 272 of the wall 266 and then it is directed through the wall 266 (length wise) to an outer edge 276 of the wall 266 where it produces the light effect 278B. As should be

appreciated, the light effect 278A alters the visual appearance of the surface of the wall 266, while light effect 278B alters the visual appearance of the edge of the wall 266.

In another embodiment, the light 268 emitted by the light source 264 is made incident on both the inner edge 272 and the inner surface 270 of the wall 266 via an offset LED. Referring to Fig. 18B, for example, the light source 264 includes an LED 290 that is offset relative to the wall 266 and that generates light 292 so as to illuminate a surface and an edge of the wall 266 of the illuminable housing 262. That is, the light 292 emitted by the LED 290 is made incident on both the inner surface 270 and the inner edge 272 of the wall 266. As such, a first portion of the light 290 is directed through the wall 266 (width wise) to the outer surface 274 of the wall 266 where it produces the light effect 278A that alters the visual appearance of the surface of the wall 266. In addition, a second portion of the light 290 is directed through the wall 266 (length wise) to the outer edge 276 of the wall 266 where it produces a light effect 278B that alters the visual appearance of the edge of the wall 266.

In another embodiment, the wall 266 includes light scattering particles and the light 268 emitted by the light source 264 is made incident on the inner edge 276 via an LED. Referring to Fig. 18C, for example, the wall 266 includes a plurality of light scattering particles 294 disposed between the inner and outer surfaces 270, 274 and the inner and outer edges 272, 276. Furthermore, the light source 264 includes an LED 296 configured to generate light 298 so as to illuminate a surface and an edge of the wall 266 of the illuminable housing 262. The light 298 emitted by the LED 296 is made incident on an inner edge 272 of the wall 266. The light 298 is then directed through the wall 266 (length wise) to an outer edge 276 of the wall 266 where it produces the light effect 278B that alters the visual appearance of the surface of the wall 266. As shown, the light 298 also intersects the light scattering particle 294 during transmission therethrough and thus a portion of the light 298 is scattered outwards in a plurality of directions where it produces the light effect 278A that also alters the visual appearance of the surface of the wall 266.

In another embodiment, the wall 266 can include a light scattering coating and the light 268 emitted by the light source 264 is made incident on an inner edge 272 via an LED. Referring to Fig. 18D, for example, the wall 266 includes a light scattering

coating 300 that is applied to the inner surface 270. Furthermore, the light source 264 includes an LED 302 configured to generate light 304 so as to illuminate a surface and edge of the wall 266 of the illuminable housing 262. The light 304 emitted by the LED 302 is made incident on the inner edge 272 of the wall 266. The light 304 is then 5 directed through the wall 266 (length wise) to an outer edge 276 of the wall 266 where it produces the light effect 278B that alters the visual appearance of the edge of the wall 266. As shown, the light 304 also intersects the light scattering coating 300 during transmission through the wall and thus a portion of the light 304 is scattered outwards in a plurality of directions where it produces the light effect 278A that also alters the visual 10 appearance of the surface of the wall 266.

Fig. 19 is a perspective diagram of a computer system 310, in accordance with another embodiment of the present invention. By way of example, the computer system 310 may generally correspond to the computer 150 of Fig. 9. The desktop computer 15 system 310 generally includes an illuminable housing 312 that is illuminated with light from an illuminated object 314 disposed therein. The illuminable housing 312 generally includes a translucent or semi-translucent wall 316 configured to allow the passage of light. In the illustrated embodiment, the illuminated object 314 is seen through the translucent or semi-translucent wall 316. That is, the illuminated object 314 generates a 20 first light effect (not shown) that is transmitted through a surface of the wall 316 to produce a second light effect 320 that alters the visual appearance of the computer system 310. As should be appreciated, the shape of the light effect 320 typically corresponds to the shape of the illuminated object 314. By way of example, the illuminated object 314 may take on a variety of shapes including simple shapes such as 25 squares and circles or more complex shapes such as an apple (as shown).

To facilitate discussion, Fig. 20 is a top view, in cross section, of the computing device 310 shown in Fig. 19, in accordance with one embodiment of the invention. As shown, the illuminated object 314 is disposed inside the illuminable housing 312. The 30 illuminated object 314 is generally positioned adjacent to the wall 316 of the illuminable housing 312. It should be noted, however, that this is not a limitation and that the illuminated object 314 may be positioned at other locations inside the housing 312. For example, the illuminated object 314 may be placed towards the center of the housing 312. Furthermore, the illuminated object 314 may be positioned in various directions so

long as a first light effect 322 is made incident on an inner surface 324 of the wall 316. For example, the axis of the illuminated object may be pointing directly at the inner surface 324 or they may be pointing at an angle relative to the inner surface 324.

5 Furthermore, the wall 316 is configured to transmit the light effect 322 therethrough from the inner surface 324 to an outer surface 326, i.e., the wall provides a window for passing the first light effect therethrough. By way of example, the wall 316 may be formed from a translucent or semi-translucent plastic such as polycarbonate, acrylic and the like.. Accordingly, the first light effect 322 that passes through the wall

10 316 effectively changes the appearance of the computing device 310. In some cases, the wall 316 may also be configured to scatter the transmitted light effect to produce a characteristic glow that emanates from the outer surface of the wall 316. That is, the wall 316 may include a light directing element that scatters the light via reflection and/or refraction.

15

 To elaborate further, the illuminated object 314 generally includes a light source 330 and a casing 332. The casing 332, which typically forms the shape of the illuminated object 314, includes a casing wall 334 that is configured to cover at least a portion of the light source 330. In the illustrated embodiment, the light source 330

20 consists of a plurality of light emitting diodes 336 (LED's) that are disposed at various positions inside the casing 332. The LED's 336 may be a single LED or an LED array. The LED's 336 are generally configured to generate light 338 so as to illuminate the casing wall 334. As such, the LED's 336 may be positioned in various directions so long as the light 338 is made incident on an inner surface of the casing wall 334.

25 Furthermore, the wall 316 is configured to transmit the light 338 therethrough from the inner surface to an outer surface. By way of example, the wall 334 may be formed from a translucent or semi-translucent plastic such as polycarbonate, acrylic and the like.. In most cases, the casing wall 334 is configured to scatter the transmitted light to produce a characteristic glow that emanates from the outer surface of the casing wall 334. For

30 instance, the casing wall 334 might include a light directing element that scatters the light via reflection and/or refraction.

Fig. 21 is a side view of a light source arrangement 380, in accordance with one embodiment of the present invention. By way of example, the light source arrangement

380 may generally correspond to any of the light sources (e.g., light emitting devices) described above. The light source arrangement 380 includes a light source 382 and a light pipe 384. The light source 382 is configured to generate light 383 and the light pipe 384 is configured to distribute the light 383 to locations within a housing where it is needed. By way of example, the housing may correspond to any one of the illuminable housings described above. The light pipe 384 generally includes a transmissive portion 386 at its interior and a reflective portion 388 at its exterior. Because the exterior of the light pipe 384 is reflective, the light 383 reflects off the sides of the pipe as it travels through the interior of the light pipe. Accordingly, when light 383 is made incident on an inner edge 390 of the light pipe it is directed through the light pipe via the transmissive and reflective portions to an outer edge 392 of the light pipe where it emits the light to another location positioned away from the location of the light source.

Any suitable light pipe may be used. For example, the light pipe may be rigid or flexible (as shown). Flexible light pipes allow a wider range of light source positions relative to housing positions. For example, the light source may be positioned in locations that prevent direct exposure to an illuminable portion of the housing, and thus the light pipe may be used to distribute the light to the illuminable portions of the housing by bending around components that prevent direct exposure (e.g., walls, frames and the like). In one embodiment, the light source is housed within an opaque portion of the housing, and a light pipe is used to direct light to an illuminable portion of the housing so as to produce the desired light effect. Furthermore, multiple light pipes may be used to direct light to a plurality of locations around the housing. This may be done with a single light source or multiple light sources. For example, a single light source may be used to provide light to a plurality of light pipes, each of which has one end position proximate the light source and an opposite end positioned in different locations within the housing.

Fig. 22 is a side view of a light source arrangement 400, in accordance with one embodiment of the present invention. By way of example, the light source arrangement 400 may generally correspond to any of the light sources (e.g., light emitting devices) described above. The light source arrangement 400 includes a light source 402 and a light guide 404, which is configured to focus light 406 generated by the light source 402. The light guide 404, which covers a portion of the light source 402, is typically formed

from an opaque material such that the light 406 emanating from the light source 402 is only directed out of an opening 408 formed by the light guide 404. In this manner, the light exiting the opening has a shaped configuration that is more intense. The shaped configuration tends to illuminate a smaller portion of the housing than would otherwise be illuminated. The opening 408 may form any number of shapes. For example, the opening may form a circle, an oval, a square, a rectangle, a triangle, a letter, a logo or any other shape. In this particular embodiment, the light guide 404 is configured to cover the sides of the light source 402. In some cases, it may be desirable to use a light guide to block light from reaching light sensitive areas of the electronic device or to prevent heat sensitive areas from becoming to hot.

Fig. 23 is a side view of a light source arrangement 410, in accordance with one embodiment of the present invention. By way of example, the light source arrangement 410 may generally correspond to any of the light sources (e.g., light emitting devices) described above. The light source arrangement 410 includes a light source 412 and a lens 414, which is configured to focus light 416 generated by the light source 412. The lens 404, which is typically positioned between the light source 402 and the illuminable wall (not shown), is arranged to receive light emanating from the light source 402 and to direct the light to a specific area of the illuminable wall. In this manner, the light has a shaped configuration that is more intense. As mentioned above, the shaped configuration tends to illuminate a smaller portion of the housing than would otherwise be illuminated.

Fig. 24 is a top view, in cross section, of a computer system 420, in accordance with one embodiment of the present invention. By way of example, the computer system 420 may generally correspond to any of the computer systems described above. As shown, the computer system 420 includes a housing 422 and a light source 424 disposed therein. In the illustrated embodiment, the housing 422 consists of three parts: end cap 422A, a body 422B and a front face 422C. The end cap 422A closes off one side of the body 422B and the front face 422C closes off another side of the body 422B. Any suitable arrangement of light passing and light blocking walls may be used. In the illustrated embodiment, the end cap 422A and front face 422C are typically formed from a light blocking material while the body 422B is formed from a material that allows the passage of light (e.g., translucent or semi-translucent material). The computer system

420 also includes a reflector 426. The reflector 426 is positioned between the light source 424 (which is located towards the end cap 422A) and the front face 422C. In the illustrated embodiment, the reflector 426 is positioned in front of a display 428. The reflector 426 is configured to redirect the light 430 generated by the light emitting device 5 424. As shown, the light 430 from the light emitting device 424 is reflected off the surface of the reflector 426 to a first portion 432 of the body 422B. The first portion is defined by B. The reflected light 431 made incident on the inner surface of the body 422B is subsequently transmitted through the wall of the body 422B and out the outer surface of the first portion 432 of the body 422B at the portion 432. Thus, light is 10 prevented from passing through a second portion 434 of the body 422B.

15 Although the principles of Figs. 21-24 are described singularly, it should be noted that they may be combined in some cases to produce other types of light arrangements. For example, any combination of a light pipe, light guide, light lens and/or a reflector may be used to distribute light within a housing.

Fig 25 is a simplified diagram of a chameleonic electronic device 440, in accordance with one embodiment of the invention. By way of example, the chameleonic electronic device 440 may generally correspond to the chameleonic electronic device 10 shown in Fig. 1. The chameleonic electronic device 440 generally includes a housing 442 that is divided into several independent and spatially distinct illuminable zones 444. As shown, the zones 444 are positioned around the periphery of the housing 442. The periphery may correspond to any portion of the housing such as the top, bottom, and sides of the housing. Any number of zones may be used. In the illustrated embodiment, 20 the housing 442 includes 12 illuminable zones 444. Each of the zones 444 has an associated light element 446, which is disposed inside the housing 442 proximate the zone 444. As should be appreciated, the associated light element 446 is configured to light up its corresponding zone 444 so as to change the ornamental appearance of the housing. By way of example, the associated light element may be an LED array capable 25 of illuminating the corresponding zone with a plurality of colors (e.g., the LED array may include a red, green and blue LED). As shown, each of the zones 444 is configured 30 to provide a light output 448.

The zones may be configured to produce a variety of ornamental appearances. In one embodiment, the zones are arranged to produce a uniform ornamental appearance. This is generally accomplished by sending the same light command signal to each of the light elements. For example, each of the zones may produce the same green light output 5 so as to produce a uniform green housing. In another embodiment, the zones are arranged to produce a patterned ornamental appearance. This is generally accomplished by sending different light command signals to the light elements. For example, a first set of alternating zones may produce a red light output, and a second set of alternating zones may produce a blue light output in order to produce a housing with stripes. In another 10 embodiment, the zones are arranged to produce a changing ornamental appearance. This is generally accomplished by sending different light command signals to the light elements at different times. For example, each of the zones may be arranged to activate at different times to produce a light sequence such as blinking, fading in and out, strobes or moving from one zone to another.

15

Fig. 26 is a broken away diagram of a general purpose computer 450, in accordance with one embodiment of the present invention. The general purpose computer 450 includes a housing 452 which encloses internal components 454 associated with operating the general purpose computer 450. The housing 452, which 20 includes several walls that define the peripheral form of the housing, is broken away between a top and a bottom so as to show the internal components therein. As shown, the internal components 454 may include a motherboard 456 that supports a CPU 458, RAM 460, ROM 462, a hard drive 464, a disk drive 466, expansion slots and boards 468, and the like. The internal components 454 may also include a power supply 470 25 and other associated circuitry such as heat sinks 472 and fans 474 for cooling the internal components 454. The housing 452 may also include a plurality of ports 476 for connection to peripheral devices located outside the housing 452. In addition, the housing 452 may include an indicator 477 and a power switch 478. In some cases, a monitor may be one of the internal components 454.

30

The internal components 454 may also include one or more light emitting diodes (LED's) 480. The LED's 480 are generally configured to generate light within the housing 452. By way of example, the LED's 480 may generate light found within the color spectrum. The light is used to colorize or patternize the housing 452. This is

generally accomplished by directing the light through illuminable portions of the housing 452. That is, the LED's 480 produce light having a variety of colors and patterns so as to give the illuminable portions of the housing 452 a color or pattern. In one embodiment, the illuminable portions are capable of diffusing the light so that the 5 illuminable portions appear to glow when light is directed therethrough. The LED's 480 may be disposed centrally, peripherally or both so as to allow the light to reach the illuminable portions of the housing 452. For example, although the LED's 480 are centrally located in Fig. 26, the LED's 480 may be disposed closer to the walls of the housing 452 so as to circumvent light blocking components contained within the housing 10 452. The LED's 480 may be controlled by a separate processor or by the CPU 458 that also controls the operation of the general purpose computer.

The size of the illuminable portion generally constitutes a substantial portion of the entire housing 452. By substantial, it is meant that the area of the illuminable portion 15 is large enough to effect the overall appearance of the general purpose computer 450 when light is passed therein. In essence, the LED's are dedicated to altering the appearance of the housing 452 so that people may break free from the neutral-passive colors and patterns that have dominated the housings of general purpose computers for so long. In one embodiment, the illuminable portion covers the entire housing 452. In 20 another embodiment, the illuminable portion covers one or more walls of the housing 452 (in their entirety). In another embodiment, the illuminable portion covers a part of two or more walls of the housing 452. In another embodiment, the illuminable portion covers a significant part of a wall of the housing 452. In another embodiment, the area of the illuminable portion is substantially larger than any of the switches, connectors or 25 indicators located on the housing 452. These type of devices are typically too small to effect the overall appearance of the general purpose computer. That is, they typically do not cover a significant part of the wall to which they are attached.

Although Fig. 26 is directed at a general purpose computer, it should be 30 appreciated that LED's may be placed in other devices associated with the general purpose computer. For example, LED's may be placed in housings of peripheral devices such as input devices (e.g., mice) or output devices (e.g., speakers) that are connected to the general purpose computer. In the case of input devices, the input devices are arranged to serve its primary function of inputting data while communicating other data

via the LED's. In the case of output devices, the output devices are arranged to serve their primary function of outputting data while communicating other data via the LED's. In either case, the LED's may be controlled by the main CPU of the general purpose computer or a separate processor of the general purpose computer.

5

While this invention has been described in terms of several preferred embodiments, there are alterations, permutations, and equivalents, which fall within the scope of this invention. It should also be noted that there are many alternative ways of implementing the methods and apparatuses of the present invention. It is therefore 10 intended that the following appended claims be interpreted as including all such alterations, permutations, and equivalents as fall within the true spirit and scope of the present invention.

What is claimed is:

1. A computing device, comprising:
an illuminable housing having a housing wall configured to allow the passage of
5 light; and
a light emitting device disposed inside the illuminable housing, the light emitting device being configured to produce a light effect that alters the ornamental appearance of the computing device.
- 10 2. The computing device as recited in claim 1 wherein the housing wall has a contour that helps to define the outer peripheral form of the illuminable housing.
- 15 3. The computing device as recited in claim 1 wherein the light emitting device includes a light source configured to generate the light so as to illuminate the interior of the illuminable housing.
4. The computing device as recited in claim 3 wherein the light source includes at least one light emitting diode.
- 20 5. The computing device as recited in claim 3 wherein the light source includes a plurality of light emitting diodes.
6. The computing device as recited in claim 5 wherein each of the light emitting diodes generate the same color of light.
- 25 7. The computing device as recited in claim 5 wherein each of the light emitting diodes generate individually different colors of light.
8. The computing device as recited in claim 7 wherein the light emitting diodes
30 cooperate to produce a light effect having a single color.
9. The computing device as recited in claim 7 wherein the light emitting diodes cooperate to produce a light effect having a plurality of colors.

10. The computing device as recited in claim 5 wherein the plurality of light emitting diodes are integrated into a light emitting diode array.
11. The computing device as recited in claim 10 wherein the light emitting diode array includes a blue, red and green light emitting diode.
12. The computing device as recited in claim 3 wherein the light illuminates an inner surface of the housing wall to effect an appearance change in an outer surface of the housing wall.

10

13. The computing device as recited in claim 3 wherein the light illuminates an inner edge of the housing wall to effect an appearance change in an outer edge of the housing wall.
15. 14. The computing device as recited in claim 3 further including a shaped wall disposed between the light source and the housing wall, and wherein the light from the light source illuminates an inner surface of the shaped wall to produce a shaped light effect at an outer surface of the shaped wall.
20. 15. The computing device as recited in claim 3 further including a light pipe for distributing the light to locations within the illuminable housing.
16. The computing device as recited in claim 3 further including a light guide for focussing the light generated by the light source.

25

17. The computing device as recited in claim 3 further including a lens for focussing the light generated by the light source.
30. 18. The computing device as recited in claim 3 further including a reflector for redirecting the light to locations within the illuminable housing.
19. The computing device as recited in claim 3 wherein the light emitting device further comprises a light source controller in communication with the light source, said

light source controller being configured to process light commands to produce the light in a controlled manner via the light source.

20. The computing device as recited in claim 1 wherein the housing wall is capable 5 of producing a characteristic glow at the outer periphery of the housing wall when the light is transmitted through the housing wall.

21. The computing device as recited in claim 1 wherein the housing is configured to enclose internal components associated with the operation of the computing device.

10

22. The computer system as recited in claim 21 wherein the illuminable housing is configured to cover and protect the internal components.

15

23. The computing device as recited in claim 21 wherein the internal components comprise a processor.

24. The computing device as recited in claim 21 wherein the internal components comprise a display controller, input controller or output controller.

20

25. The computing device as recited in claim 21 wherein the internal components comprise a display that is distinctly separate from the light emitting device.

26. The computing device as recited in claim 21 wherein the internal components comprise an input or output device.

25

27. The computing device as recited in claim 1 wherein the light effect is static.

28. The computing device as recited in claim 1 wherein the light effect is dynamic.

30

29. The computing device as recited in claim 1 wherein the computing device is a general purpose computer.

30. The computing device as recited in claim 29 wherein the general purpose computer is a desktop computer.

31. The computing device as recited in claim 29 wherein the general purpose computer is a laptop computer.
- 5 32. A computer system having a housing for enclosing at least one component of the computer system, the housing having a light passing wall, the computer system comprising:
 - a light source disposed inside the housing, the light source being configured to generate light; and
 - 10 a light controller operatively coupled to the light source, the light source controller being configured to control the light source so as to illuminate at least a portion of the light passing wall of the housing with the light generated by the light source.
- 15 33. The computer system as recited in claim 32 wherein the light source is dedicated to illuminating the light passing wall.
34. The computer system as recited in claim 32 wherein the light source is not a display.
- 20 35. The computer system as recited in claim 32 wherein the light source controller is disposed inside the housing.
36. The computer system as recited in claim 32 further comprising a processor
- 25 configured to carry out operations associated with the computer system, the processor being operatively coupled to the light source controller.
37. The computer system as recited in claim 36 wherein the processor is disposed inside the housing.
- 30 38. The computer system as recited in claim 32 further comprising:
 - a display; and
 - a display controller configured to process display commands to produce text or graphics on the display.

39. The computer system as recited in claim 38 wherein the display is disposed inside the housing.

5 40. The computer system as recited in claim 38 wherein the display controller is disposed inside the housing.

10 41. The computer system as recited in claim 32 further comprising:
an input/output controller configured to control interactions with one or more input/output devices that can be operatively coupled to the computer system.

42. The computer system as recited in claim 41 wherein the input/output controller is disposed inside the housing.

15 43. The computer system as recited in claim 32 further comprising:
a processor configured to carry out operations associated with the computer system, the processor being operatively coupled to the light source controller;
a display;
a display controller operatively coupled to the processor and the display, the display controller being configured to process display commands to produce text or graphics on the display; and
an input/output controller operatively coupled to the processor, the input/output controller being configured to control interactions with one or more input/output devices that can be operatively coupled to the computer system.

20

25 44. The computer system as recited in claim 43 wherein housing is configured to enclose the light source controller, the processor, the display, the display controller, the input/output controller and at least one input/output device.

30 45. The computer system as recited in claim 43 wherein housing is configured to enclose the light source controller, the processor, the display controller and the input/output controller.

46. The computer system as recited in claim 43 wherein housing is configured to enclose the display.

47. The computer system as recited in claim 43 wherein housing is configured to 5 enclose at least one input/output device.

48. The computer system as recited in claim 32 wherein the computer system has a second housing for enclosing a second component of the computer system, the second housing having a second light passing wall, the computer system further comprising: a 10 second light source disposed inside the second housing, the second light source being configured to generate light.

49. The computer system as recited in claim 48 wherein the light controller 15 operatively coupled to the second light source, the light source controller being configured to control the second light source so as to illuminate at least a portion of the second light passing wall of the housing with the light generated by the second light source.

50. The computer system as recited in claim 48 wherein the first housing is 20 configured to enclose a light source controller, a processor, a display controller, an input/output device controller, and wherein the second housing is configured to enclose a display.

51. The computer system as recited in claim 32 wherein the housing further includes 25 one or more opaque walls that cooperate with the one or more light passing walls to define the shape of the housing.

52. A general purpose computer having the ability to alter its ornamental appearance, the general purpose computer comprising:
30 a housing;
a computer component disposed inside the housing;
a light arrangement disposed inside the housing, the light arrangement being configured to illuminate a substantial portion of the housing so as to alter the ornamental appearance of the housing.

53. The general purpose computer as recited in claim 52 wherein the computer component is a CPU.

5 54. The general purpose computer as recited in claim 52 wherein the computer component is a display.

55. The general purpose computer as recited in claim 52 wherein the computer component is an I/O device.

10 56. A general purpose computer, comprising:
a housing including one or more walls that define the outer peripheral form of the general purpose computer, one of the walls having an illuminable portion configured to allow the passage of light therein;

15 a light emitting device enclosed by the housing, the light emitting device being configured to generate light so as to illuminate at least a portion of the light passing wall thus altering the ornamental appearance of the general purpose computer; and
a processor enclosed by the housing, the processor being configured to at least partially control the operations of the general purpose computer.

20 57. The general purpose computer as recited in claim 56 wherein the processor is coupled to the light emitting device and further configured to control the light emitting device so as to produce a light effect.

25 58. The general purpose computer as recited in claim 56 further including a second processor enclosed by the structural housing, the second processor being configured to control the light emitting device so as to produce a light effect.

30 59. The general purpose computer as recited in claim 56 wherein the illuminable portion constitutes a substantial portion of the entire housing.

60. The general purpose computer as recited in claim 59 wherein the illuminable portion constitutes the entire housing.

61. The general purpose computer as recited in claim 59 wherein the illuminable portion constitutes one or more walls of the housing.
62. The general purpose computer as recited in claim 59 wherein the illuminable portion constitutes a part of two or more walls of the housing.
5
63. The general purpose computer as recited in claim 59 wherein the illuminable portion constitutes a part of a wall of the housing.
- 10 64. The general purpose computer as recited in claim 56 wherein the area of the illuminable portion is substantially larger than any of buttons, connectors or indicators located on the housing.
- 15 65. A display for use with a general purpose computer, comprising a housing including one or more wall that define the outer peripheral form of the general purpose computer, one of the light walls being a light passing wall configured to allow the passage of light therein;
a light arrangement enclosed by the housing, the light arrangement being configured to generate light so as to illuminate the light passing wall thus altering the
20 ornamental appearance of the display; and
a display screen partially enclosed by the housing, the display screen being configured to display text or graphics via a graphical user interface.
- 25 66. A computing device comprising an enclosure having an illuminable wall in optical communication with a light source disposed inside the enclosure, said illuminable wall and said light source working together to emit a characteristic glow at a peripheral portion of said enclosure.
- 30 67. The computing device as recited in claim 66 wherein the enclosure defines the outer peripheral form of the computing device.
68. The computing device as recited in claim 66 wherein the illuminable wall is formed from a translucent or semi-translucent material

69. The computing device as recited in claim 66 wherein the illuminable wall includes a light directing element configured to scatter light from the light source, the scattered light helping to form the characteristic glow.

5 70. The computing device as recited in claim 69 wherein the light directing element is an additive disposed inside the illuminable wall.

71. The computing device as recited in claim 69 wherein the light directing element is a coating applied to the illuminable wall.

10

72. The computing device as recited in claim 69 wherein the light directing element is a textured surface of the illuminable wall.

15

73. The computing device as recited in claim 66 wherein the characteristic glow is formed at an outer surface of the illuminable wall.

74. The computing device as recited in claim 66 the characteristic glow is formed at an outer edge of the illuminable wall.

20

75. An electronic device, comprising
a housing configured to define the outer peripheral form of the electronic device;
a distinct first component disposed inside the housing and capable of inputting or
outputting information associated with the operation of the electronic device; and
a distinct second component disposed inside the housing and capable of
25 outputting light so as to illuminate a substantial portion of the housing in order to effect
the ornamental appearance of the electronic device.

1/19

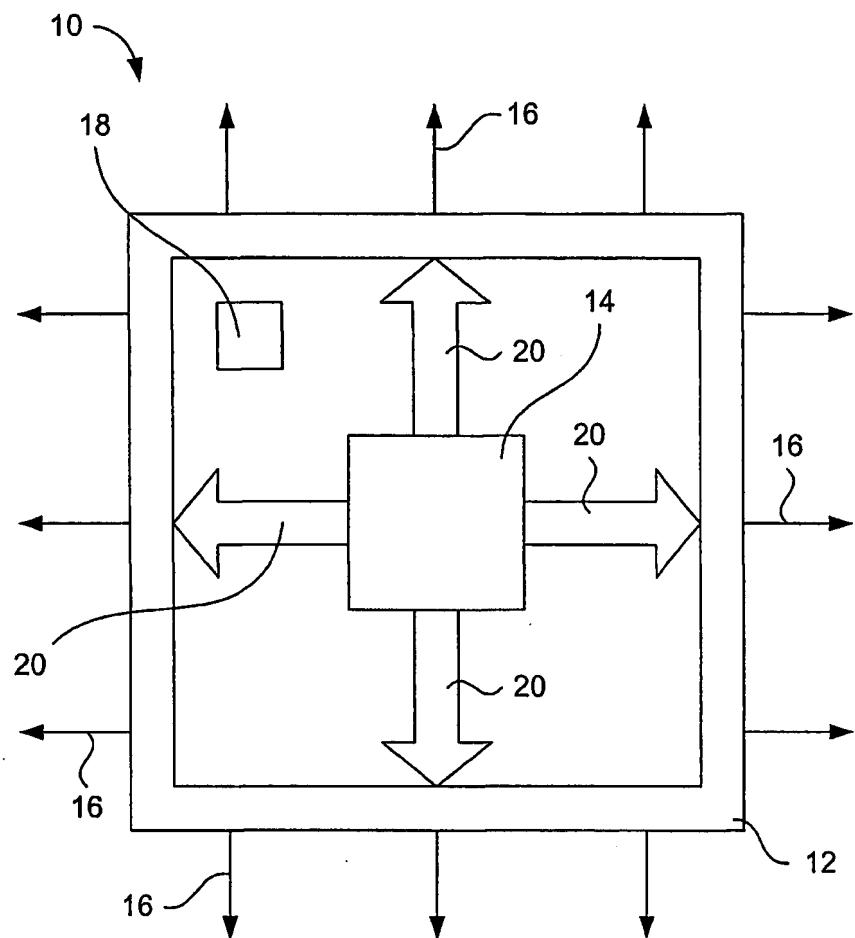


FIG. 1

2/19

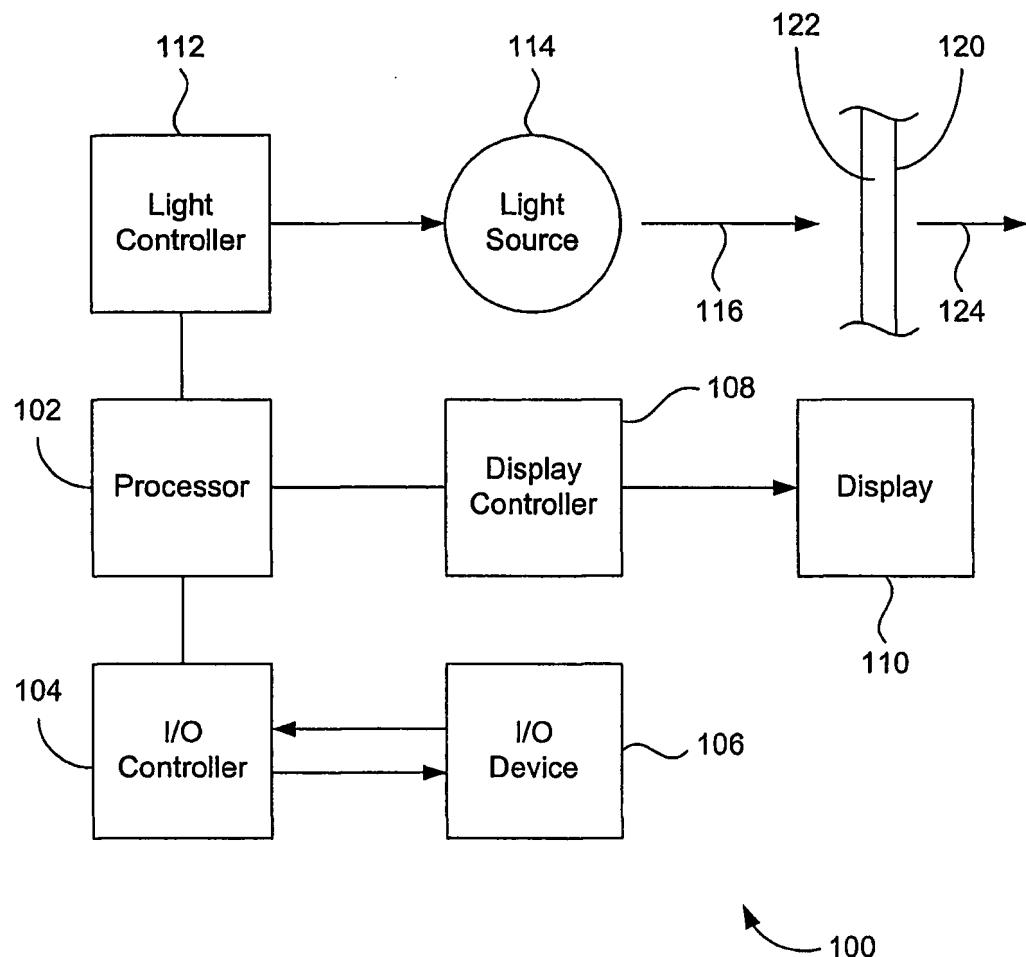


FIG. 2

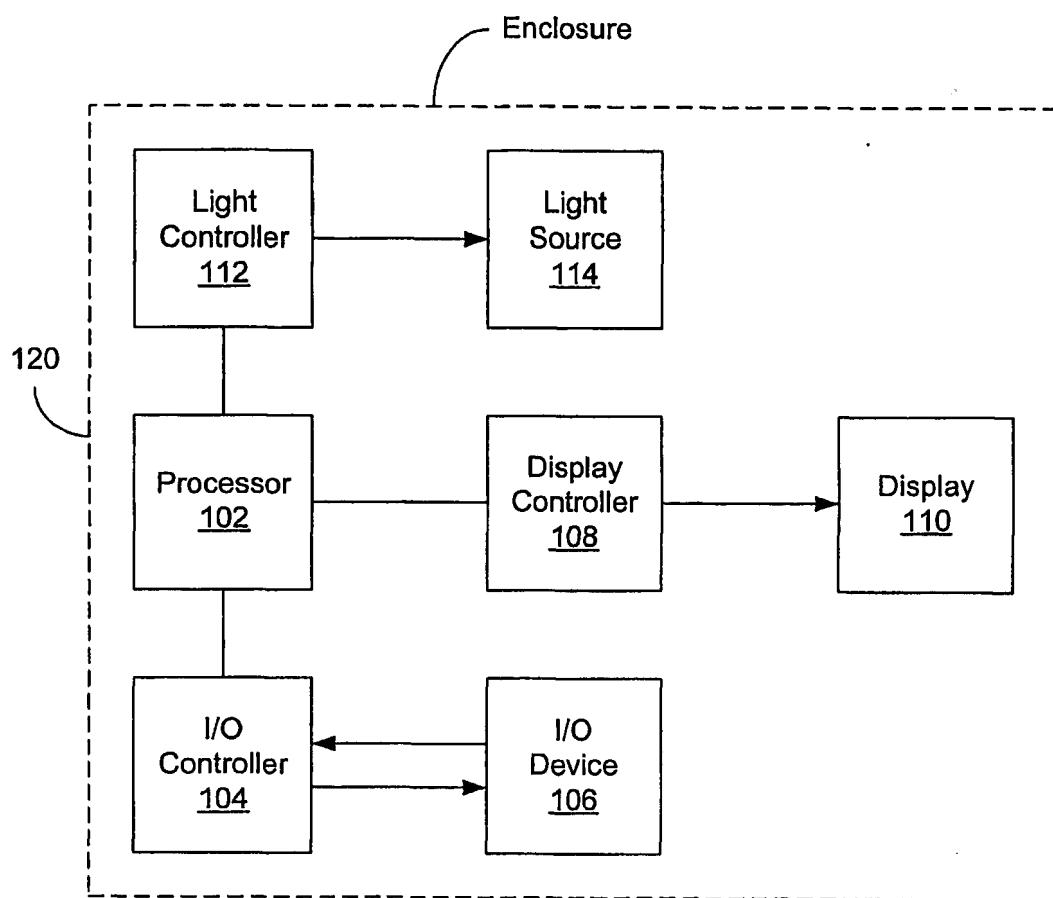


FIG. 3

4/19

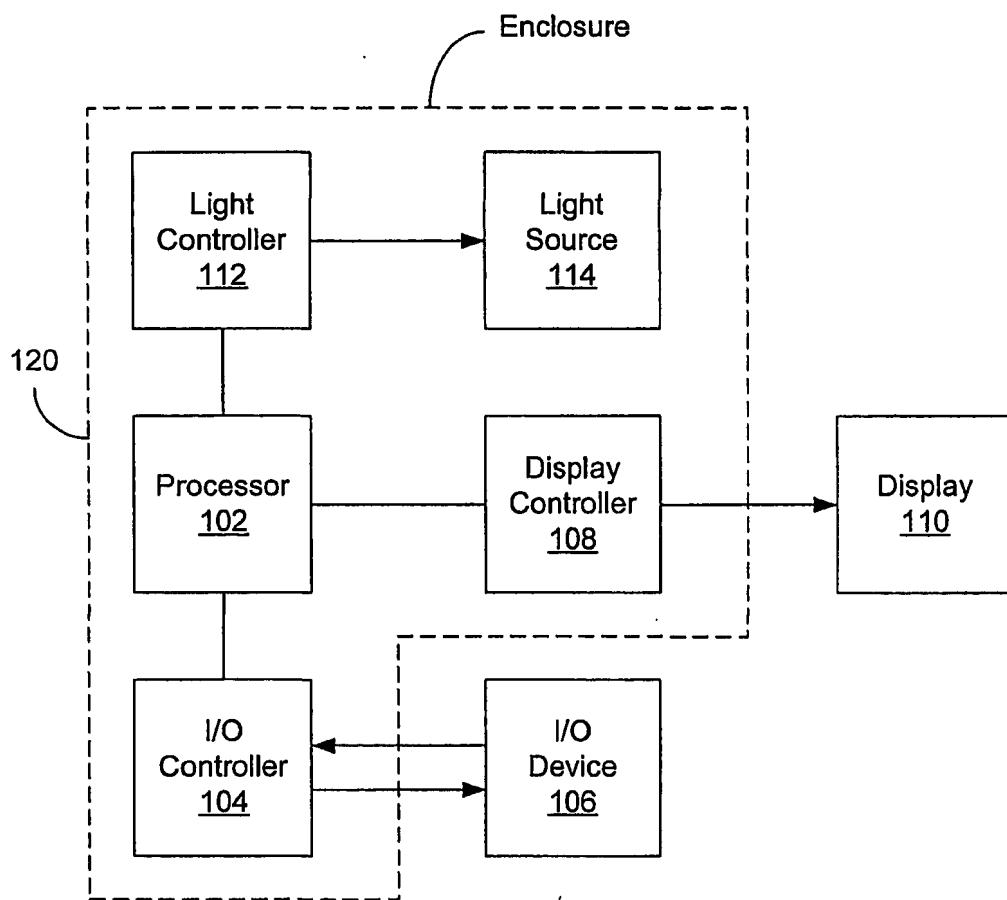


FIG. 4

5/19

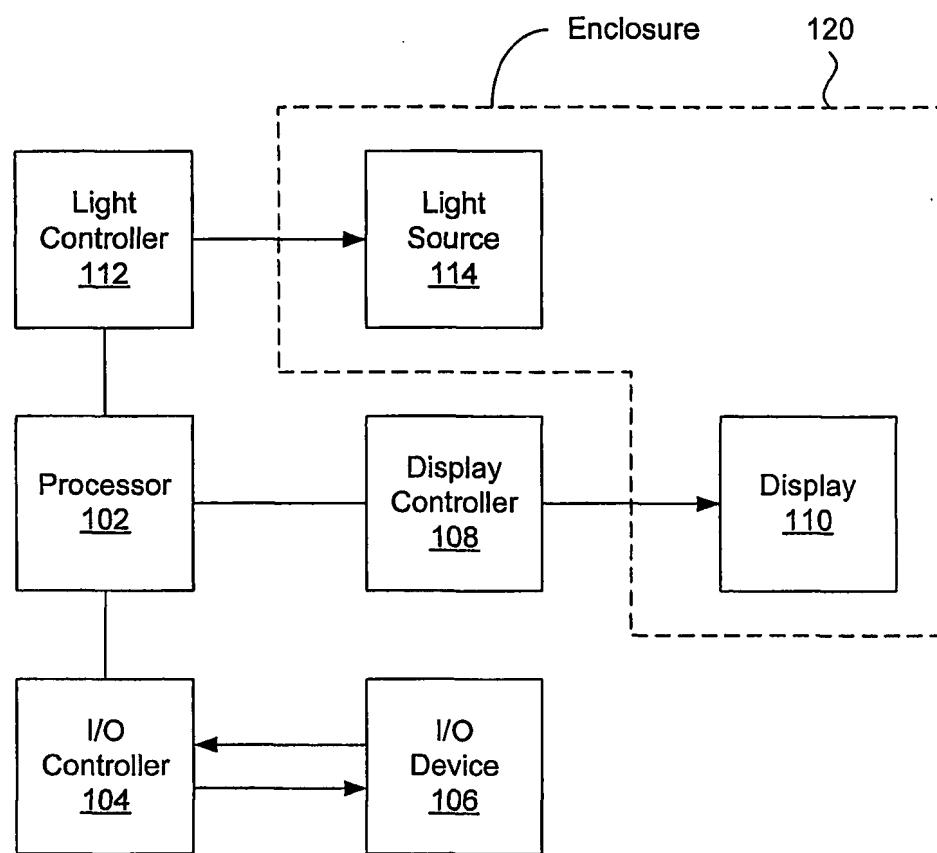


FIG. 5

6/19

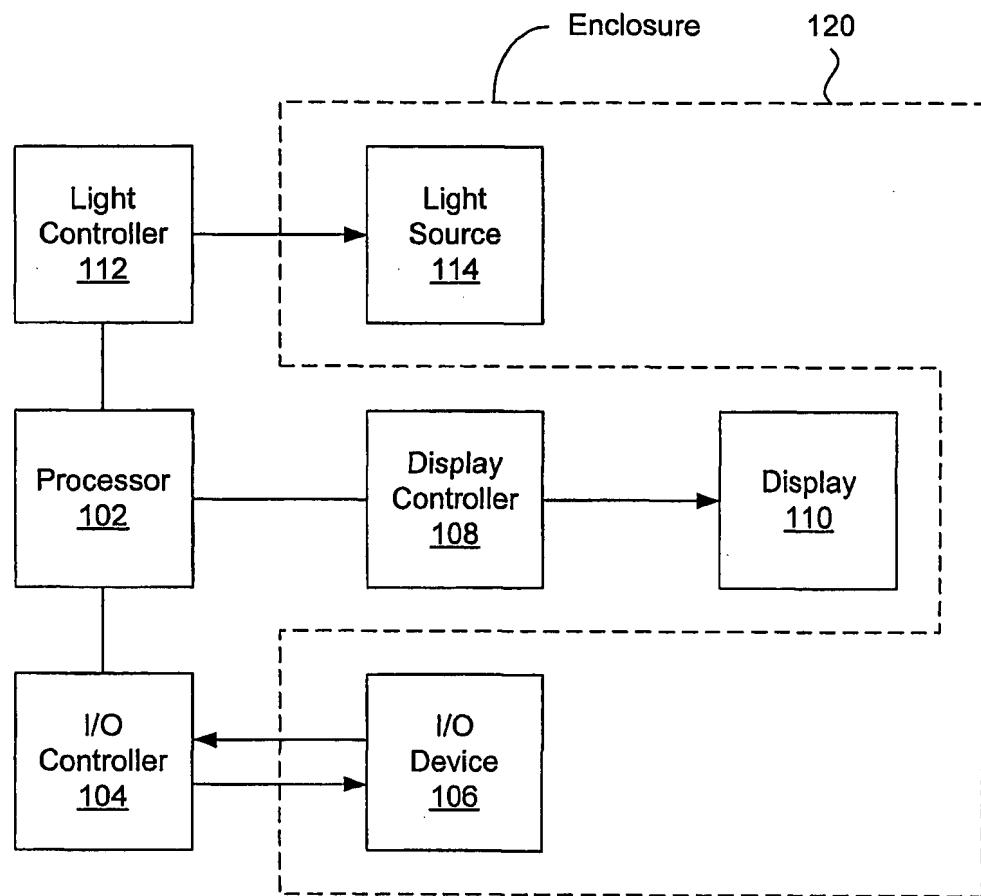


FIG. 6

7/19

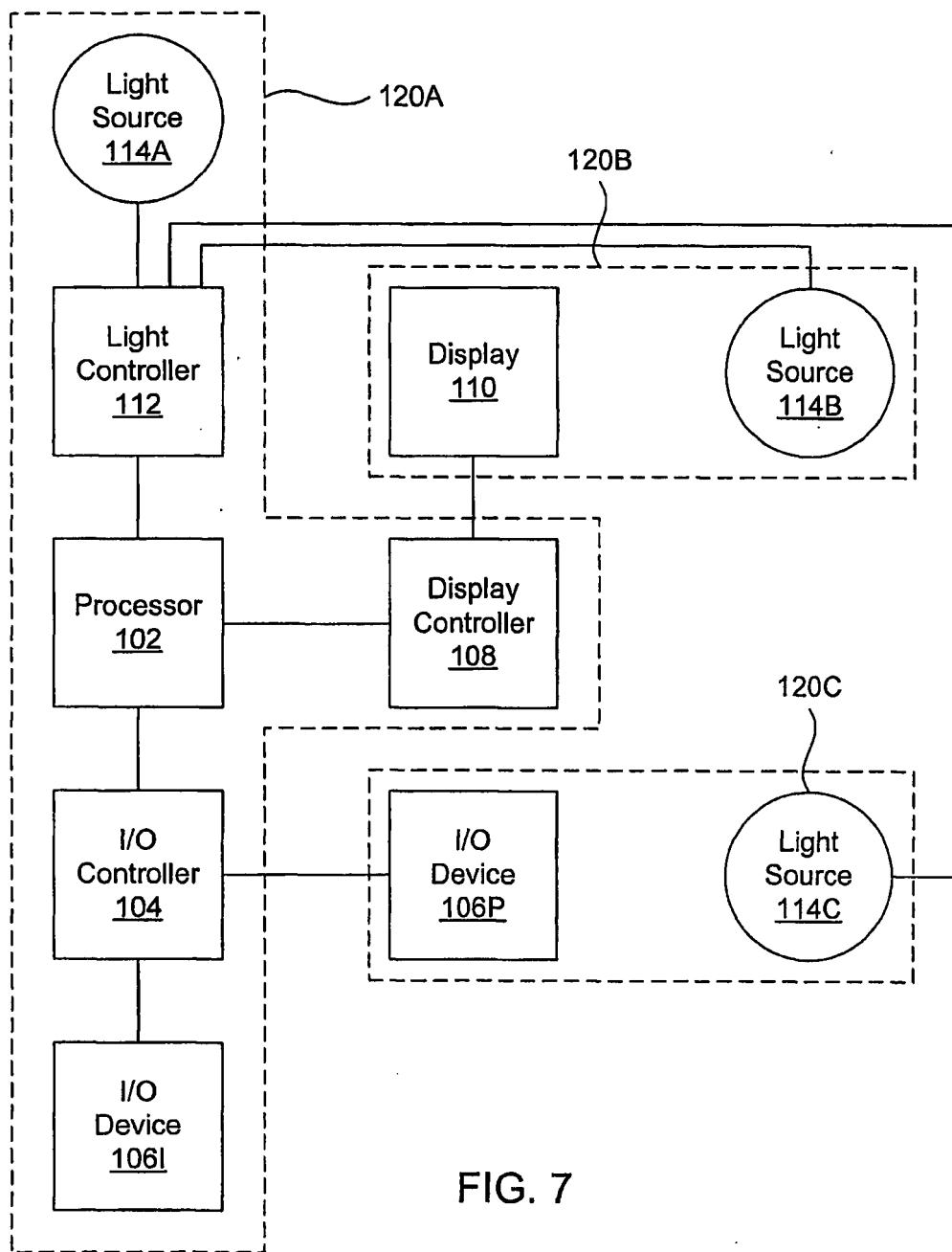


FIG. 7

8/19

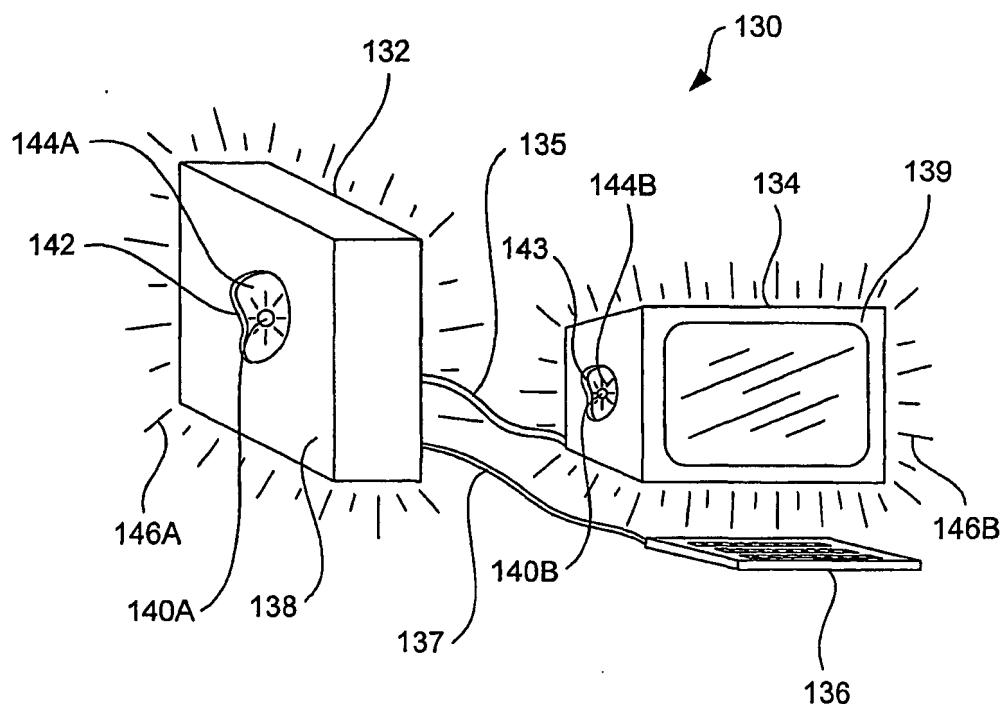


FIG. 8

9/19

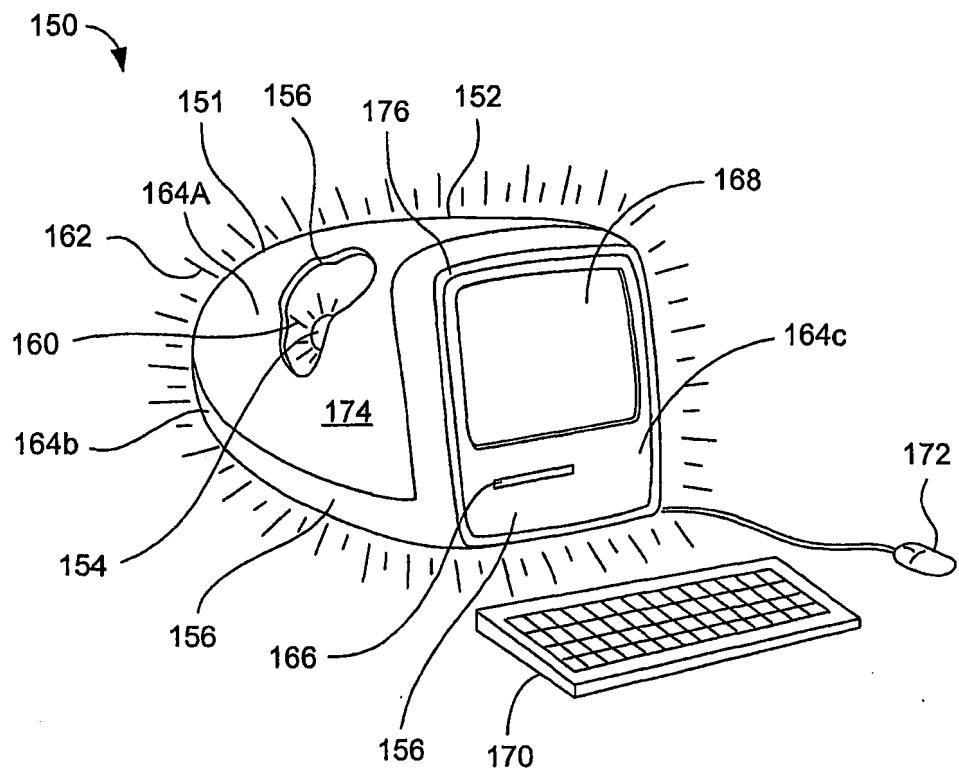


FIG. 9

10/19

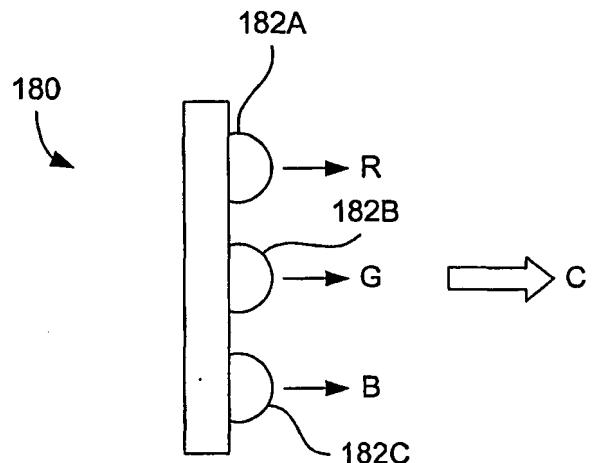


FIG. 10

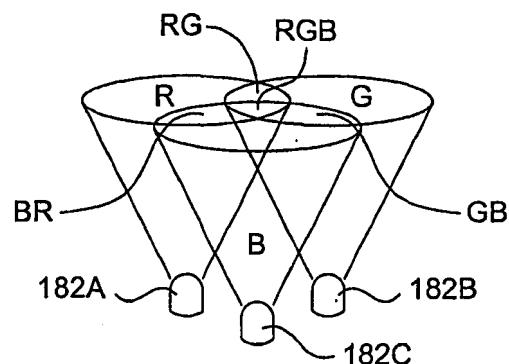


FIG. 11A

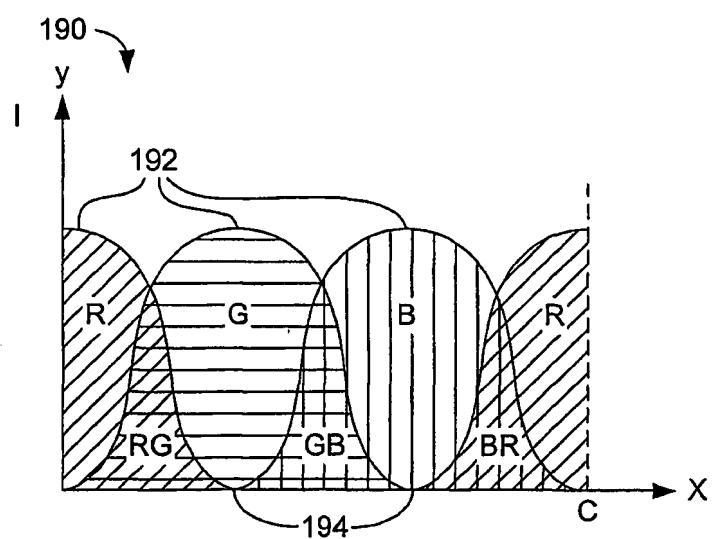


FIG. 11B

11/19

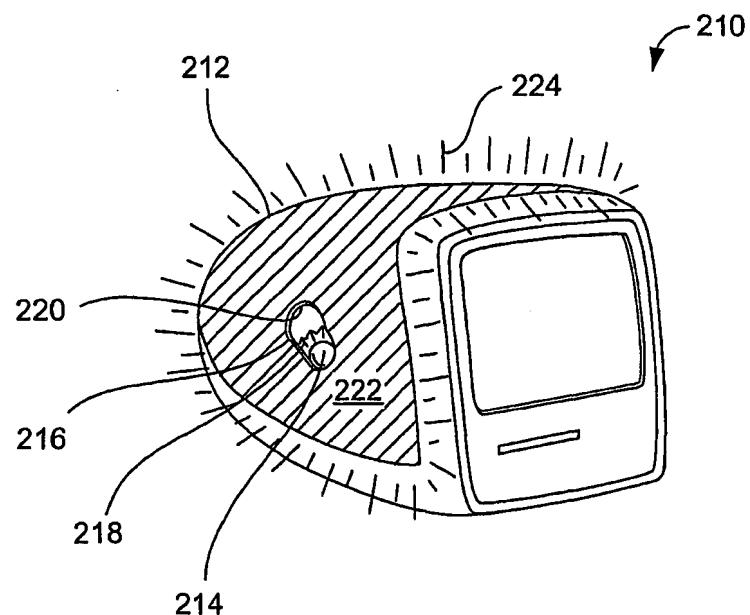


FIG. 12

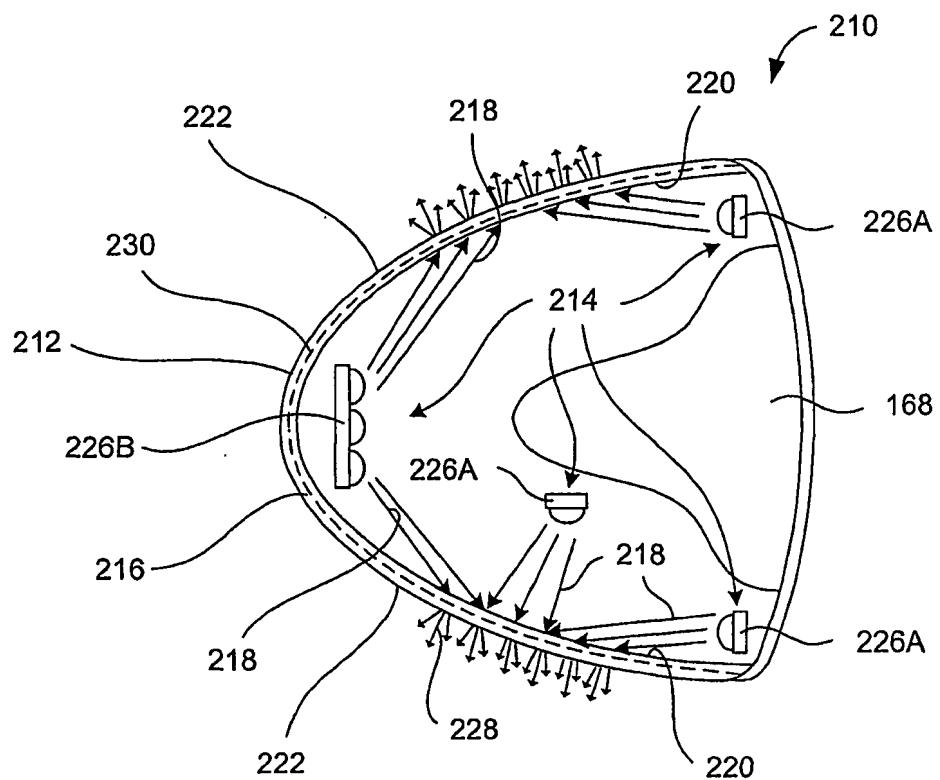


FIG. 13

12/19

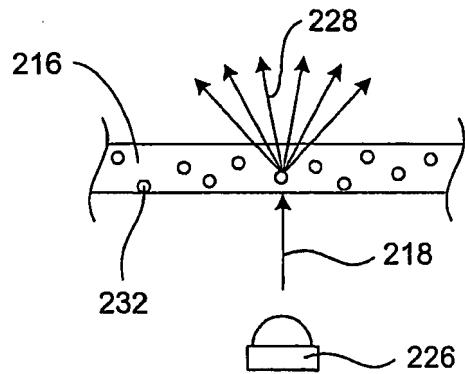


FIG. 14A

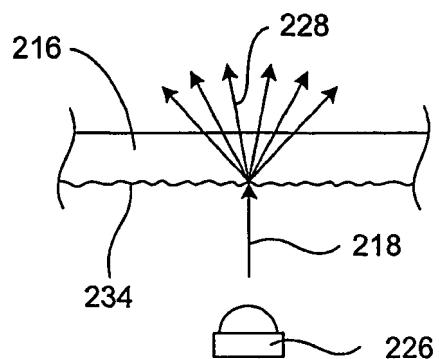


FIG. 14B

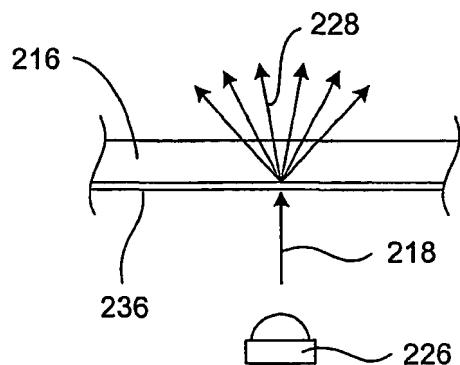


FIG. 14C

13/19

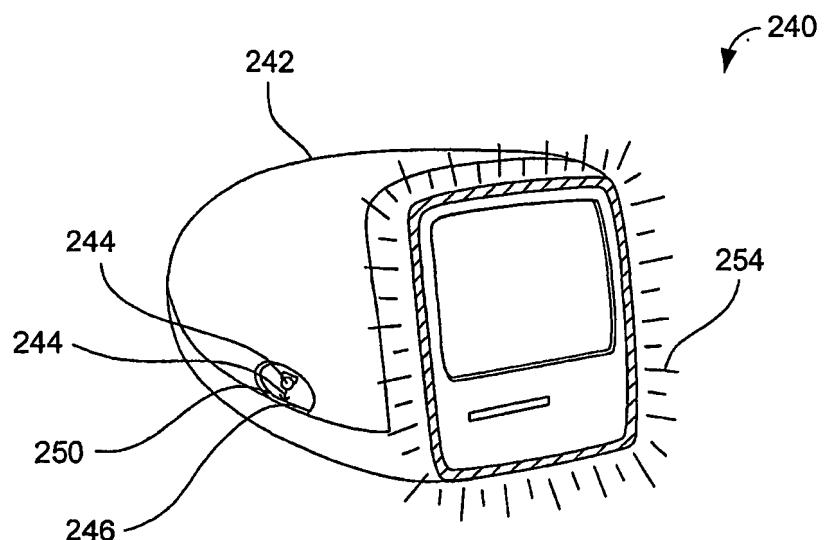


FIG. 15

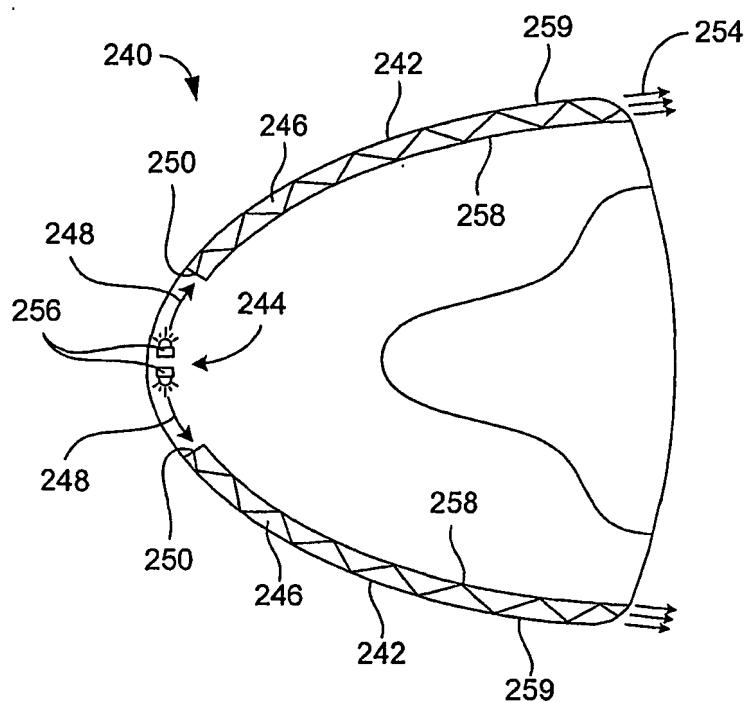


FIG. 16

14/19

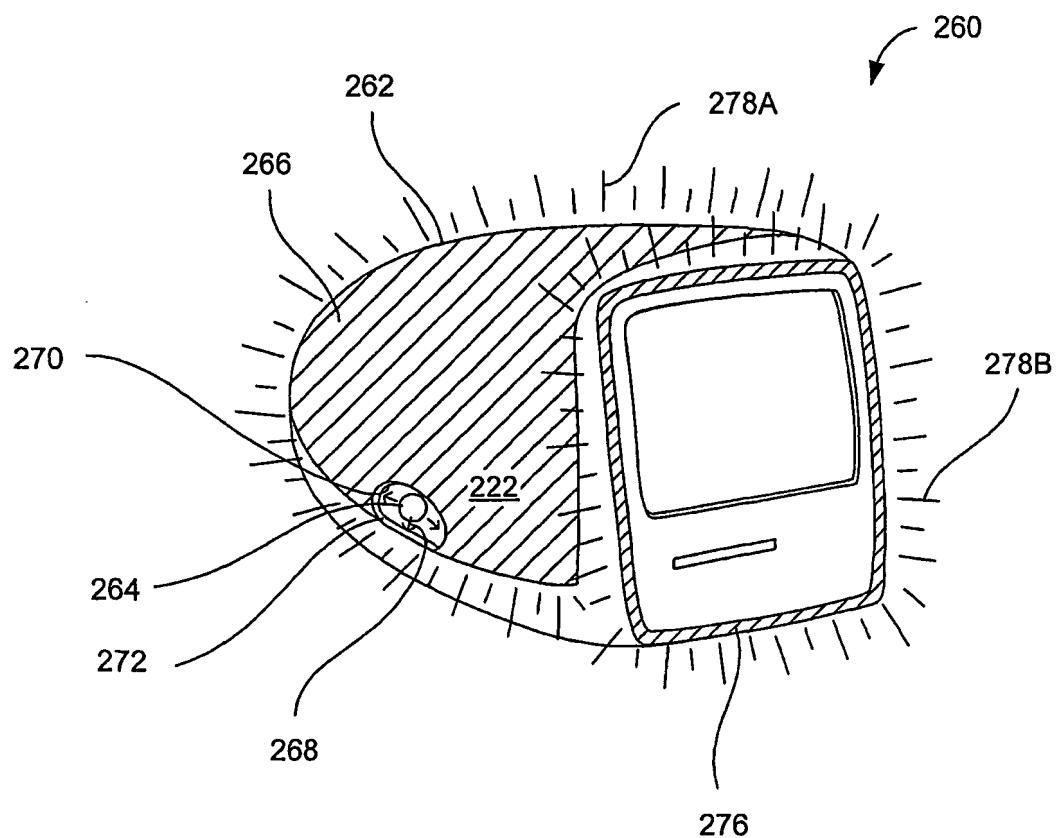


FIG. 17

15/19

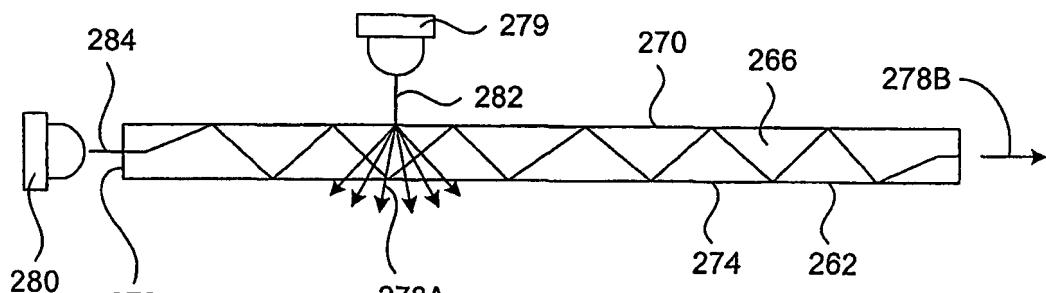


FIG. 18A

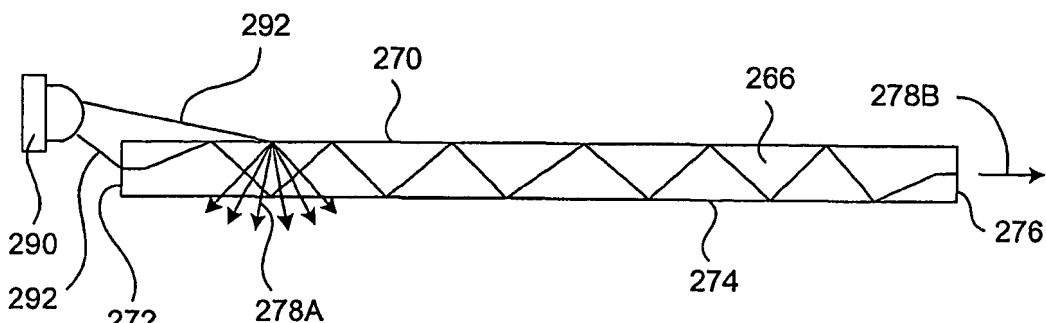


FIG. 18B

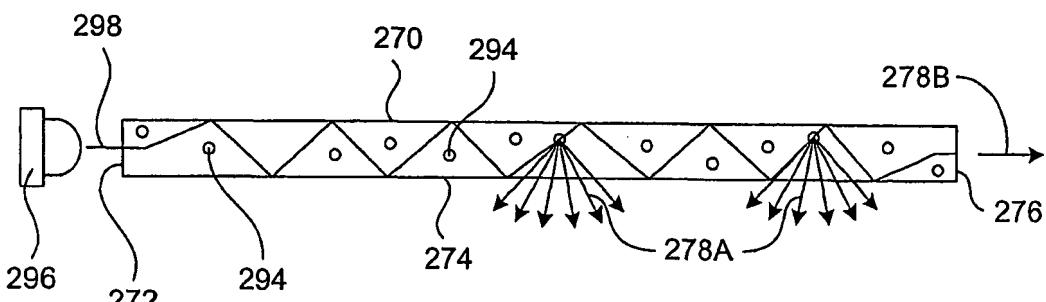


FIG. 18C

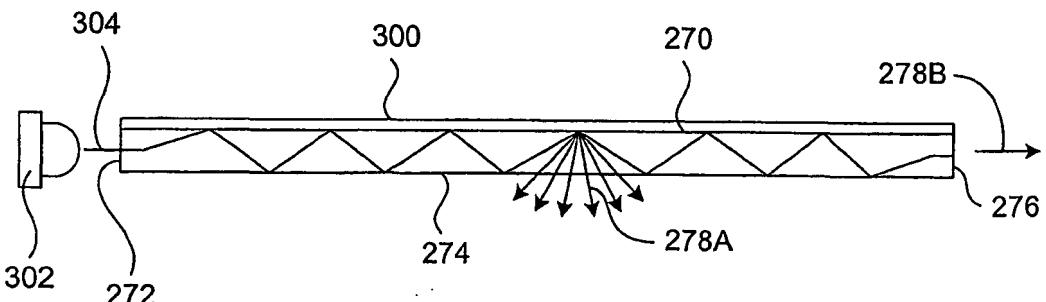


FIG. 18D

16/19

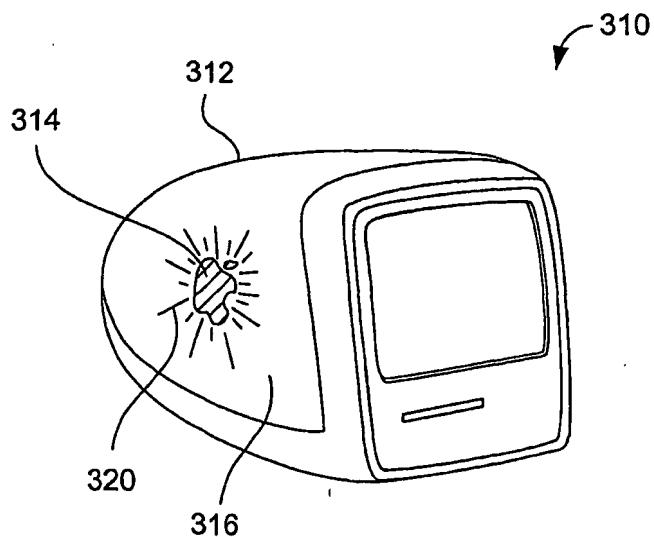


FIG. 19

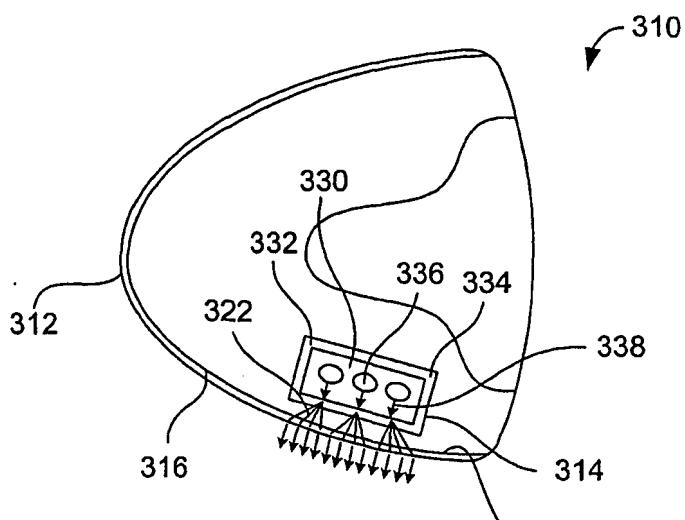


FIG. 20

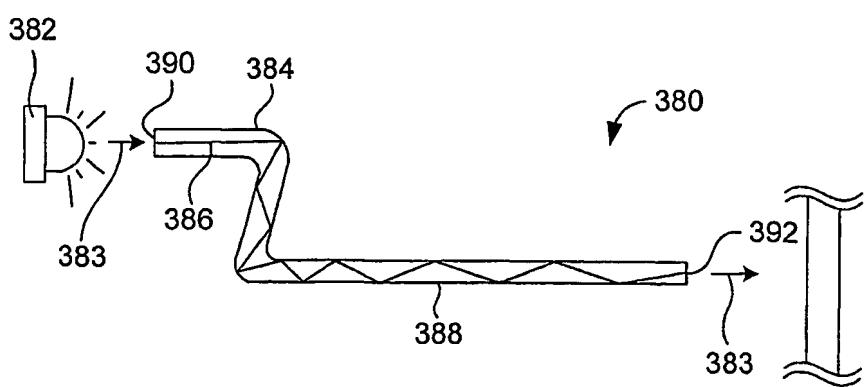


FIG. 21

17/19

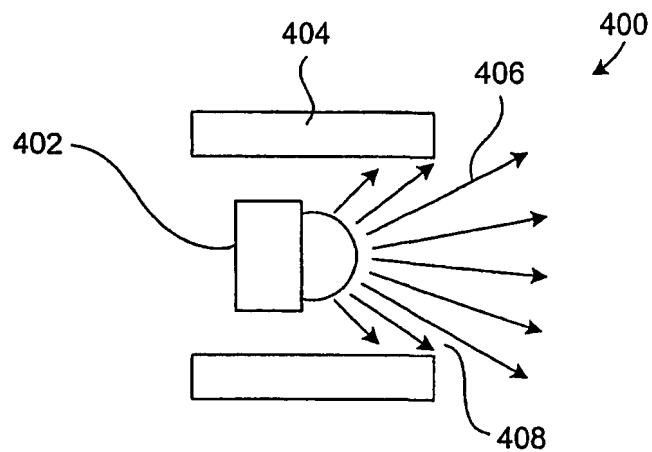


FIG. 22

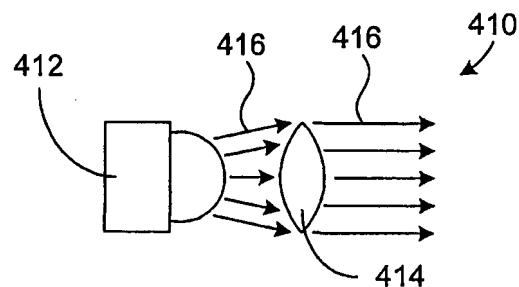


FIG. 23

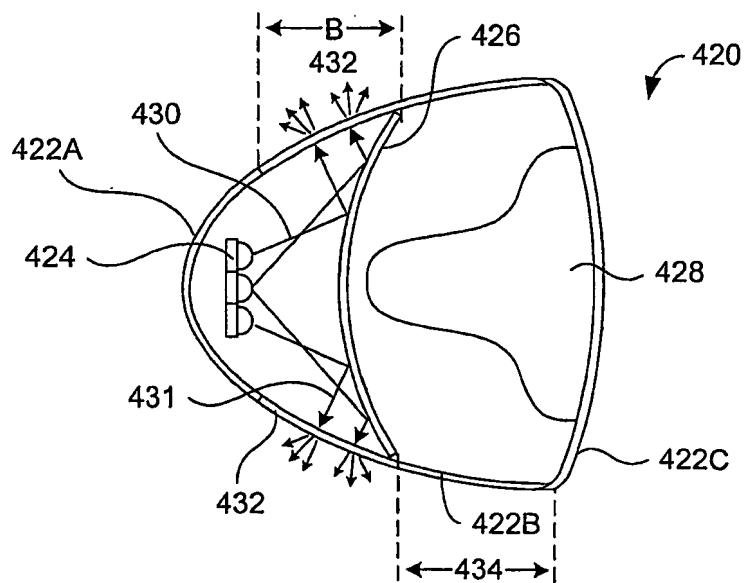


FIG. 24

18/19

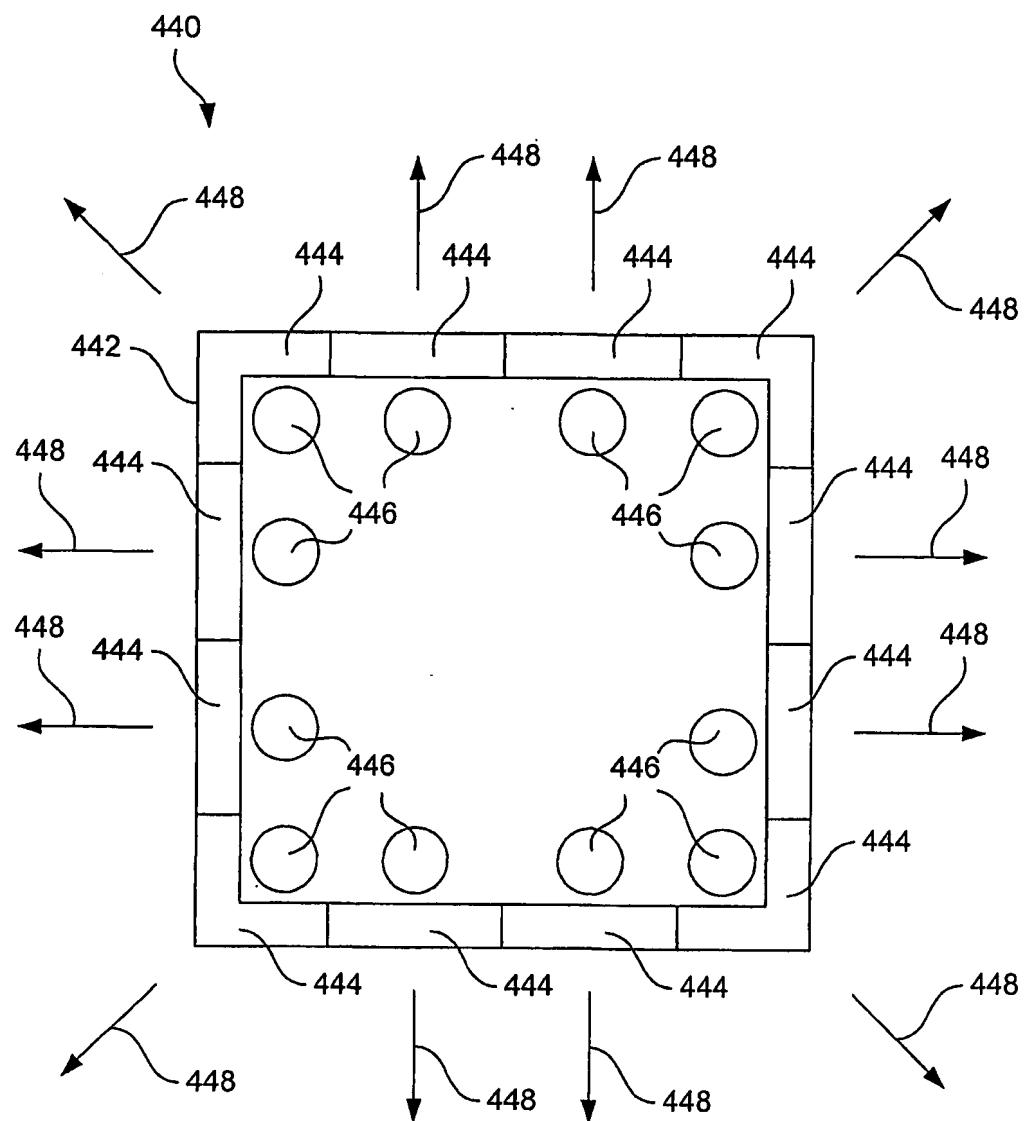


FIG. 25

19/19

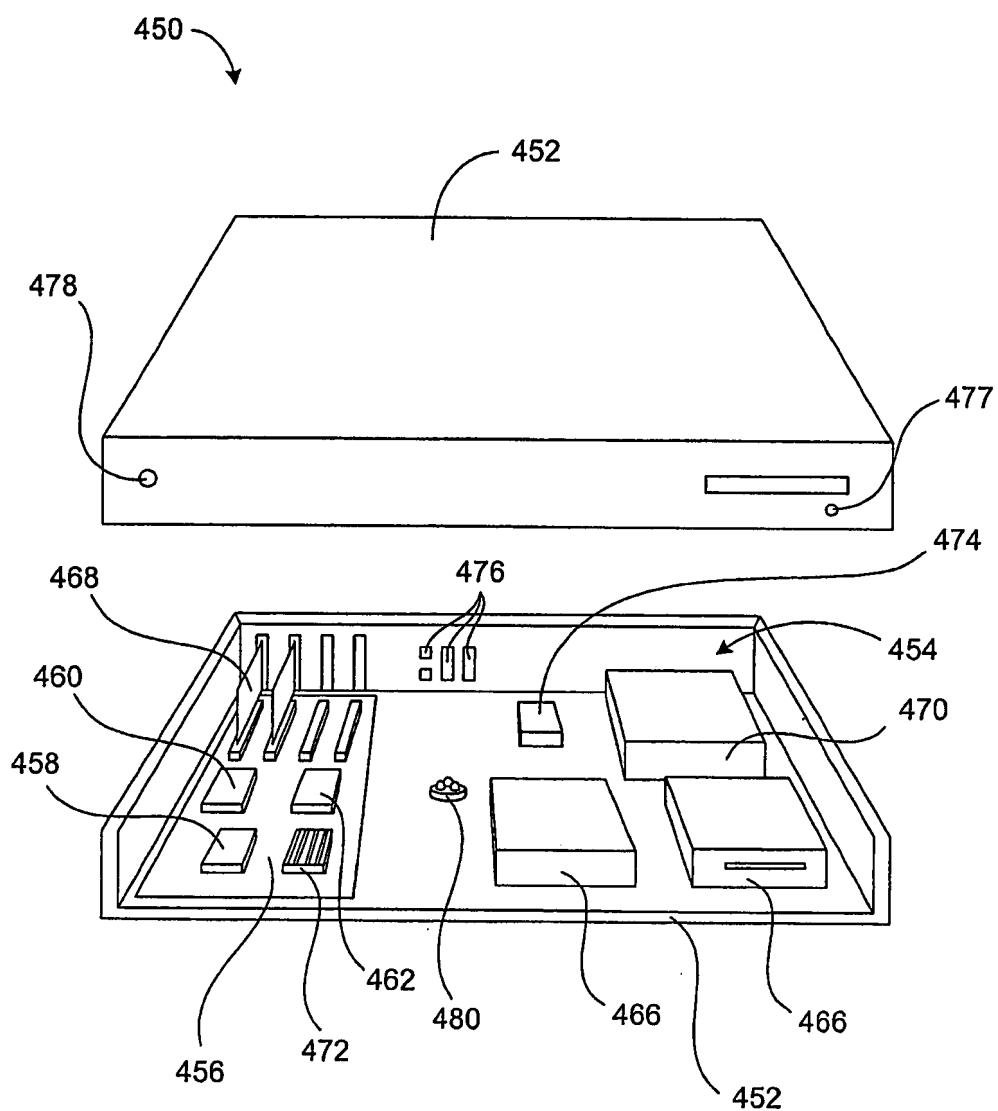


FIG. 26